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Langley Research Center

Scientific and Technical Information Program Office

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Scientific and Technical Aerospace Reports (STAR) is an electronic abstract journal, listing citations with abstracts for aerospace-related reports obtained from worldwide sources. It is electronically published biweekly and announces documents that have recently been entered into the NASA Scientific and Technical Information (STI) Database. The documents are of the following types:

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- Domestic and foreign dissertations and theses.

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STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

Abstracts in *STAR* are categorized by 10 major subject divisions that are divided further into 76 specific subject categories. The subject divisions and categories are listed in the Table of Contents together with a note for each that defines its scope and provides any cross-references.

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Subject Divisions

Document citations are grouped first by the following divisions. Select a division title to view the category-level Table of Contents.

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F. Life Sciences
G. Mathematical and Computer Sciences
H. Physics
I. Social Sciences
J. Space Sciences
K. General

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.

Subject Term Index
Personal Author Index

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Subject Categories of the Division A. Aeronautics

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01 Aeronautics (General)

02 Aerodynamics

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information, see also *34 Fluid Mechanics and Heat Transfer.*

03 Air Transportation and Safety

Includes passenger and cargo air transport operations; and aircraft accidents. For related information, see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 Aircraft Communications and Navigation

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information, see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications Radar.*

05 Aircraft Design, Testing and Performance

Includes aircraft simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Urban Technology and Transportation*.

06 Aircraft Instrumentation

Includes cockpit and cabin display devices; and flight instruments. For related information, see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 Aircraft Propulsion and Power

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information, see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

08 Aircraft Stability and Control

Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance*.

09 Research and Support Facilities (Air)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information, see also *14 Ground Support Systems and Facilities (Space).*

Subject Categories of the Division B. Astronautics

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

12 Astronautics (General)

For extraterrestrial exploration, see *91 Lunar and Planetary Exploration*.

13 Astrodynamics

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 Ground Support Systems and Facilities (Space)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. *For related information, see also 09 Research and Support Facilities (Air).*

15 Launch Vehicles and Space Vehicles

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information, see also *20 Spacecraft Propulsion and Power.*

16 Space Transportation

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits, see *54 Man/System Technology and Life Support*.

17 Space Communications, Spacecraft Communications, Command and Tracking

Includes telemetry; space communication networks; astronavigation and guidance; and radio blackout. For related information, see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 Spacecraft Design, Testing and Performance

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems, see *54 Man/System Technology and Life Support*. For related information, see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation*.

19 Spacecraft Instrumentation

For related information, see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 Spacecraft Propulsion and Power

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles*.

Subject Categories of the Division C. Chemistry and Materials

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

23 Chemistry and Materials (General)

24 Composite Materials

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials*.

25 Inorganic and Physical Chemistry

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics*.

26 Metallic Materials

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 Nonmetallic Materials

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

28 Propellants and Fuels

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

29 Materials Processing

Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology.*

Subject Categories of the Division D. Engineering

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31 Engineering (General)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 Communications and Radar

Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking*. For search and rescue see 03 Air Transportation and Safety, and *16 Space Transportation*.

33 Electronics and Electrical Engineering

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

34 Fluid Mechanics and Heat Transfer

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 Instrumentation and Photography

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

36 Lasers and Masers

Includes parametric amplifiers. For related information see also *76 Solid-State Physics*.

37 Mechanical Engineering

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 Quality Assurance and Reliability

Includes product sampling procedures and techniques; and quality control.

39 Structural Mechanics

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

42 Geosciences (General)

43 Earth Resources and Remote Sensing

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

44 Energy Production and Conversion

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

45 Environment Pollution

Includes atmospheric, noise, thermal, and water pollution.

46 Geophysics

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation*.

47 Meteorology and Climatology

Includes weather forecasting and modification.

48 Oceanography

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

51 Life Sciences (General)

52 Aerospace Medicine

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 Behavioral Sciences

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 Man/System Technology and Life Support

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

55 Space Biology

Includes exobiology; planetary biology; and extraterrestrial life.

Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

59 Mathematical and Computer Sciences (General)

60 Computer Operations and Hardware

Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering*.

61 Computer Programming and Software

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 Computer Systems

Includes computer networks and special application computer systems.

63 Cybernetics

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

64 Numerical Analysis

Includes iteration, difference equations, and numerical approximation.

65 Statistics and Probability

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 Systems Analysis

Includes mathematical modeling; network analysis; and operations research.

67 Theoretical Mathematics

Includes topology and number theory.

Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

70 Physics (General)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics*.

71 Acoustics

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

72 Atomic and Molecular Physics

Includes atomic structure, electron properties, and molecular spectra.

73 Nuclear and High-Energy Physics

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

74 Optics

Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers*.

75 Plasma Physics

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics*.

76 Solid-State Physics

Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 Thermodynamics and Statistical Physics

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

Subject Categories of the Division I. Social Sciences

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80 Social Sciences (General)

Includes educational matters.

81 Administration and Management

Includes management planning and research.

82 Documentation and Information Science

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software*.

83 Economics and Cost Analysis

Includes cost effectiveness studies.

84 Law, Political Science and Space Policy

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 Urban Technology and Transportation

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

Subject Categories of the Division J. Space Sciences

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88 Space Sciences (General)

89 Astronomy

Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 Astrophysics

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics*.

91 Lunar and Planetary Exploration

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

92 Solar Physics

Includes solar activity, solar flares, solar radiation and sunspots. For related information see also *93 Space Radiation.*

93 Space Radiation

Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics.*

Subject Categories of the Division K. General

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99 General

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 37, MAY 10, 1999

01
AERONAUTICS (GENERAL)

19990028427 Royal Aeronautical Society, London, UK

The Aeronautical Journal, Volume 101

Stollery, John L., Editor, Royal Aeronautical Society, UK; The Aeronautical Journal; November 1997; ISSN 0001-9240; 50p; In English; See also 19990028428 through 19990028433; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

This publication consists of the following articles: (1) An analytical model for ACSR approach to vibration reduction in helicopter rotor-flexible fuselage system; (2) Studies of vortex flaps for different sweepback angle delta wings; (3) Technical note: A note on the potential contribution of wing-body interference drag to the total drag of an aircraft; (4) Operational experience and test results in the adaptive test section of the DLR transonic tunnel; (5) On the use of large scale windtunnel models; (6) Efficient lift enhancement of a blunt edged delta wing.

CASI

Aerodynamics; Scale Models; Wind Tunnel Models; Aeronautical Engineering; Wind Tunnel Tests; Aerodynamic Characteristics; Aerodynamic Configurations

19990028619 Logistics Management Inst., McLean, VA USA

Aviation System Analysis Capability Executive Assistant Development

Roberts, Eileen, Logistics Management Inst., USA; Villani, James A., Logistics Management Inst., USA; Anderson, Kevin, Logistics Management Inst., USA; Book, Paul, Logistics Management Inst., USA; March 1999; 160p; In English

Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01

Report No.(s): NASA/CR-1999-209119; NS801S1; NAS 1.26:209119; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

In this technical document, we describe the development of the Aviation System Analysis Capability (ASAC) Executive Assistant (EA) Proof of Concept (POC) and Beta version. We describe the genesis and role of the ASAC system, discuss the objectives of the ASAC system and provide an overview of components and models in the ASAC system, and describe the design process and the results of the ASAC EA POC and Beta system development. We also describe the evaluation process and results for applicable COTS software. The document has seven chapters, a bibliography, and two appendices.

Author

Aeronautics; Data Systems; Information Management; Information Transfer; Systems Analysis

19990031865 NASA Langley Research Center, Hampton,VA USA

Aeronautical Engineering: A Continuing Bibliography With Indexes, Supplement 398

Apr. 16, 1999; 61p; In English

Report No.(s): NASA/SP-1999-7037/SUPPL398; NAS 1.21:7037/SUPPL398; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes - subject and author are included after the abstract section.
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19990032102 Logistics Management Inst., McLean, VA USA
A Method for Forecasting the Commercial Air Traffic Schedule in the Future ***Final Report***
Long, Dou, Logistics Management Inst., USA; Lee, David, Logistics Management Inst., USA; Gaier, Eric, Logistics Management Inst., USA; Johnson, Jesse, Logistics Management Inst., USA; Kostiuk, Peter, Logistics Management Inst., USA; January 1999; 90p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01
Report No.(s): NASA/CR-1999-208987; NS806S1; NAS 1.26:208987; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents an integrated set of models that forecasts air carriers' future operations when delays due to limited terminal-area capacity are considered. This report models the industry as a whole, avoiding unnecessary details of competition among the carriers. to develop the schedule outputs, we first present a model to forecast the unconstrained flight schedules in the future, based on the assumption of rational behavior of the carriers. Then we develop a method to modify the unconstrained schedules, accounting for effects of congestion due to limited NAS capacities. Our underlying assumption is that carriers will modify their operations to keep mean delays within certain limits. We estimate values for those limits from changes in planned block times reflected in the OAG. Our method for modifying schedules takes many means of reducing the delays into considerations, albeit some of them indirectly. The direct actions include depeaking, operating in off-hours, and reducing hub airports'operations. Indirect actions include using secondary airports, using larger aircraft, and selecting new hub airports, which, we assume, have already been modeled in the FAA's TAF. Users of our suite of models can substitute an alternative forecast for the TAF.
Author
Air Transportation; Schedules; Forecasting; Air Traffic

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also 34 Fluid Mechanics and Heat Transfer.

19990028433 Texas A&M Univ., Aerospace Engineering Dept., College Station, TX USA
Efficient lift enhancement of a blunt edged delta wing
Traub, L. W., Texas A&M Univ., USA; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 439-445; In English; See also 19990028427
Report No.(s): Paper-2338; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

A windtunnel study was undertaken to determine the effectiveness of leading edge vortex plates in enhancing the lifting abilities of a blunt edged delta wing. In the investigation, vortex plates were attached to both the upper and lower surfaces of the leading edge. Various positions of the vortex plates with respect to the wing's leading edge were evaluated. The results indicate that a vortex plate located on the upper surface of the wing is capable of increasing lift so as to be comparable to a similar sharp edged wing, while reducing drag through some retained leading edge thrust. The increase in zero lift drag associated with vortex plate attachment tends to limit potential performance improvements. A vortex plate mounted on the lower wing surface decreased lift slightly compared to the blunt wing. However, drag was found to decrease markedly.
Author
Delta Wings; Drag Reduction; Leading Edges; Vortices; Zero Lift; Wind Tunnel Tests; Vortex Flaps; Leading Edge Flaps; Lift Augmentation

19990028449 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Survey on the Aerodynamics of Battle-Damaged Combat Aircraft
Erm, Lincoln P.; Jun. 1998; 20p; In English
Report No.(s): AD-A360572; DSTO-GD-0184; DODA-AR-010-563; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A literature survey on the aerodynamics of battle-damaged combat aircraft is presented in this report. The survey considers experimental investigations carried out in wind tunnels using either scaled or full-sized models of complete aircraft or components of aircraft that have either simulated damage or actual gunfire damage. The survey could assist in the planning of a possible experimental program at AMRL to obtain aerodynamic data for battle-damaged aircraft. The data could be used in modelling the flight-dynamic behaviour of damaged aircraft.
DTIC
Fighter Aircraft; Damage; Aerodynamics; Flight Characteristics

19990028620 Allison Engine Co., Indianapolis, IN USA
ADPAC v1.0: User's Manual ***Final Report***
Hall, Edward J., Allison Engine Co., USA; Heidegger, Nathan J., Allison Engine Co., USA; Delaney, Robert A., Allison Engine Co., USA; February 1999; 268p; In English
Contract(s)/Grant(s): NAS3-27394; RTOP 538-03-11
Report No.(s): NASA/CR-1999-206600; E-11089; NAS 1.26:206600; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The overall objective of this study was to evaluate the effects of turbulence models in a 3-D numerical analysis on the wake prediction capability. The current version of the computer code resulting from this study is referred to as ADPAC v7 (Advanced Ducted Propfan Analysis Codes -Version 7). This report is intended to serve as a computer program user's manual for the ADPAC code used and modified under Task 15 of NASA Contract NAS3-27394. The ADPAC program is based on a flexible multiple-block and discretization scheme permitting coupled 2-D/3-D mesh block solutions with application to a wide variety of geometries. Aerodynamic calculations are based on a four-stage Runge-Kutta time-marching finite volume solution technique with added numerical dissipation. Steady flow predictions are accelerated by a multigrid procedure. Turbulence models now available in the ADPAC code are: a simple mixing-length model, the algebraic Baldwin-Lomax model with user defined coefficients, the one-equation Spalart-Allmaras model, and a two-equation k-R model. The consolidated ADPAC code is capable of executing in either a serial or parallel computing mode from a single source code.
Author
Applications Programs (Computers); User Manuals (Computer Programs); Prop-Fan Technology; Computational Fluid Dynamics; Turbulence Models; Computational Grids; Turbomachinery

19990031948 NASA Langley Research Center, Hampton, VA USA
Computational Test Cases for a Clipped Delta Wing with Pitching and Trailing-Edge Control Surface Oscillations
Bennett, Robert M., NASA Langley Research Center, USA; Walker, Charlotte E., Tennessee Univ., USA; March 1999; 90p; In English
Contract(s)/Grant(s): RTOP 522-31-81-03
Report No.(s): NASA/TM-1999-209104; L-17822; NAS 1.15:209104; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Computational test cases have been selected from the data set for a clipped delta wing with a six-percent-thick circular-arc airfoil section that was tested in the NASA Langley Transonic Dynamics Tunnel. The test cases include parametric variation of static angle of attack, pitching oscillation frequency, trailing-edge control surface oscillation frequency, and Mach numbers from subsonic to low supersonic values. Tables and plots of the measured pressures are presented for each case. This report provides an early release of test cases that have been proposed for a document that supplements the cases presented in AGARD Report 702.
Author
Computational Fluid Dynamics; Delta Wings; Airfoil Profiles; Control Surfaces; Pitch (Inclination); Wind Tunnel Tests; Unsteady Aerodynamics; Transonic Flow; Computerized Simulation

19990032290 NASA Ames Research Center, Moffett Field, CA USA
Selection of Slow and Fast Variables in the Three-Dimensional Flight Dynamics
Ardema, M., NASA Ames Research Center, USA; Rajan, N., Stanford Univ., USA; 19840608; 5p; In English; American Control Conference, 6-8 Jun. 1984, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A transformation from the altitude and velocity state variables of three-dimensional flight mechanics to a new set of more desirable variables is found. The new variables provide a greater time-scale separation, decrease system coupling, and give better estimates of the fast-variable values along the reduced solution. One of the new variables is the often-used specific energy, whereas

the other variable changes along a given trajectory, depending on the nature of the local reduced solution. Numerical examples are included.
Author
Flight Mechanics; Aerodynamics; Estimates

19990032430 Naval Surface Warfare Center, Carderock Div., Bethesda, MD USA
Force and Moment Calculations of an Appendage Using the Reynolds Averaged Navier-Stokes Equations ***Final Report***
Gorski, Joseph J.; Buley, Gregory M.; Jul. 1998; 29p; In English
Report No.(s): AD-A360510; CRDKNSWC/HD-1362-06; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes efforts to compute forces and moments about an appendage using the Reynolds averaged Navier-Stokes (RANS) equations. All computations presented are done with the Mississippi State University code UNCLE. Calculations are performed for a two-dimensional NACA 0012 airfoil and a three-dimensional NACA 0015 low-aspect ratio appendage mounted on a ground board. Results are presented for both forward and reverse flow conditions.
DTIC
Force; Appendages; Low Aspect Ratio; Method of Moments; Computation

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also 16 Space Transportation and 85 Urban Technology and Transportation.

19990028558 Federal Aviation Administration, Fire Safety Section, Atlantic City, NJ USA
Full-Scale Test Evaluation of Aircraft Fuel Fire Burnthrough Resistance Improvements ***Final Report***
Marker, Timothy R.; Jan. 1999; 41p; In English
Report No.(s): AD-A360550; DOT/FAA/AR-98/52; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the research and full-scale tests undertaken by the Federal Aviation Administration (FAA) to evaluate the fuselage burnthrough resistance of transport category aircraft that are exposed to large postcrash fuel fires. Twenty-eight full-scale tests were conducted in a reusable fuselage test rig to determine the effectiveness of thermal-acoustical insulation improvements in preventing or delaying fuselage burnthrough. The testing showed that the method of attaching the insulation to the fuselage structure had a critical effect on the effectiveness of the insulation material. In addition, the composition of the insulation bagging material, normally a thermoplastic film, was also shown to be an important factor. A number of fiberglass insulation modifications and new insulation materials were shown to be effective in varying degrees. For example, a heat-treated, oxidized polyacrylonitrile fiber (OPF) encased in a polyimide bagging material prevented burnthrough for over 8 minutes. When contrasted with current insulation materials, which were shown to fail in as little as 2 minutes, effective fire barriers such as the OPF insulation offer the potential of saving lives during a postcrash fire accident in which the fuselage remains intact.
DTIC
Aircraft Fuels; Flammability; Full Scale Tests; Fuselages; Transport Aircraft; Fires

19990028662 Federal Aviation Administration, Washington, DC USA
Notices to Airmen: Domestic/International
Nov. 05, 1998; 188p; In English
Report No.(s): PB99-116568; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The following topics are discussed: Airway Notams; Airports, Facilities, and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum En Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.
NTIS
Air Navigation; Airports; Flight Paths; Air Traffic Control

19990032241 Federal Aviation Administration, Airport and Aircraft Safety Research and Development, Atlantic City, NJ USA
Mixed-Phase Icing Conditions: A Review ***Final Report***
Riley, James T.; Dec. 1998; 45p; In English
Report No.(s): AD-A359346; DOT/FAA/AR-98-76; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report reviews publicly available evidence bearing upon possible safety hazards due to flight in mixed-phase conditions. Recent investigations with modern instrumentation suggest that these conditions are more frequent and widespread than had been realized. However, information characterizing these conditions which is suitable for addressing questions of aviation safety is very limited. Facility simulation of mixed-phase conditions is difficult and well-controlled simulations have been done in very few facilities in the world. It is not known how well the various methods that have been used actually simulate the natural environment, nor with what degree of fidelity it needs to be simulated for the investigation of some safety questions. The limited data available from research flights does not indicate that there is any difference in performance effects caused by structural icing resulting from flight in mixed-phase cloud rather than in purely liquid supercooled cloud.
DTIC
Ice Formation; Aircraft Icing; Flight Safety

19990032378 Federal Aviation Administration, Airport and Aircraft Safety Research and Development, Atlantic City, NJ USA
Snow and Ice Particle Sizes and Mass Concentrations at Altitudes Up to 9 km (30,000 ft) ***Final Report***
Jeck, Richard K.; Aug. 1998; 93p; In English
Report No.(s): AD-A359349; AAR-421; DOT/FAA/AR-97/66; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

About 7600 nautical miles (nm) (14,000 km) of select ice particle measurements over the USA have been compiled into a single, computerized database for use in characterizing ice crystal and snowflake (generally termed ice particle) size distributions and mass concentrations at flight altitudes. Data are from 50 research flights by six agencies in eight flight research projects using Particle Measuring Systems' one-dimensional (1-D) and two-dimensional (2-D) particle sizing probes. Primary recorded variables are average particle size distributions in the range 0.1 to 10 mm from each of 1625 microphysically uniform cloud intervals or other convenient distances in wintertime clouds, snowstorms, cirrus, and other high-altitude clouds. The findings are that, generally, the largest particles and the greatest concentrations of total ice particle mass (TIPM) are confined to altitudes below 20,000 ft (6 km). There, particles of 10 mm in maximum dimension and TIPM's up to about 3 g/cu m may be found. Above 20,000 ft, particles are smaller than 2 mm and TIPM's are less than 0.2 g/cu m in the cirrus and the upper reaches of deep winter storm clouds that are found at these levels. Exceptions are thunderstorm anvil clouds where 10 mm particles and TIPM's of at least 1 g/cu m can be found up to at least 30,000 ft (9 km). Anvil clouds and stratiform clouds associated with warm season mesoscale convective systems have provided some of the largest TIPM's, the greatest particle concentrations, and the largest particle sizes at high and mid altitudes, respectively. In contrast to supercooled cloud droplets where the largest liquid water (mass) concentrations are confined to short distances of 3 nm or less in convective clouds, the largest average TIPM's in glaciated clouds have been found in layer clouds over distances up to 30 nm.
DTIC
Ice Formation; Flight Safety; Cloud Physics; Aircraft Icing; Mesoscale Phenomena; Particle Mass; Snow

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Urban Technology and Transportation.

19990028428 California Univ., Mechanical and Aerospace Engineering Dept., Los Angeles, CA USA
An analytical model for ACSR approach to vibration reduction in a helicopter rotor-flexible fuselage system
Chiu, T., California Univ., USA; Friedmann, P. P., California Univ., USA; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 399-408; In English; 22nd; European Rotocraft Forum, Sep. 1996, Brighton, UK; See also 19990028427
Contract(s)/Grant(s): DAAH04-93-G-0004
Report No.(s): Paper-2256; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

This paper describes the development of a coupled rotor-flexible fuselage model which is suitable for simulating vibration reduction based on the active control of structural response (ACSR) approach. The rotor is an N(sub b)-bladed aeroelastic model, with coupled flap-lag-torsional dynamics for each blade. Moderate blade deflections are included, together with complete coupling between rotor and fuselage dynamics. This aeroelastic response model is combined with a control algorithm based on an internal model principle. The control scheme effectively reduces vibrations to 0.05g levels or lower, using reasonable actuator forces. The baseline vibration levels in the fuselage are relatively high. This is due to the lack of damping modelling in the fuselage.

With the actuators engaged, the hub loads remain virtually unchanged and therefore this control approach has no influence on vehicle airworthiness.
Author
Active Control; Aeroelasticity; Rotor Dynamics; Vibration Damping; Rotor Aerodynamics; Mathematical Models; Dynamic Response; Actuators

19990028429 Tokyo Univ., Dept. of Aeronautics and Astronautics, Japan
Studies of vortex flaps for different sweepback angle delta wings
Rinoie, K., Tokyo Univ., Japan; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 409-416; In English; CEAS European Forum on High Lift and Separation Control, 1995, Bath, UK; See also 19990028427
Report No.(s): Paper-2271; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

Low speed windtunnel measurements were made on a 50 deg. delta wing with leading edge vortex flaps. Improvements in the lift/drag ratio were obtained by deflecting the leading edge vortex flap. Comparisons were made between the previously measured 60 and 70 deg. delta wing results and the present 50 deg. wing results. Improvements in the lift/drag ratio of the 50 deg. delta wing were attained over a wider lift coefficient range than for the 70 deg. delta wing. The highest lift/drag ratio for the 50 deg. delta wing is achieved when the flow attaches to the flap surface without any large area of separation. Estimations of the aerodynamic forces were also made using a quasi-vortex lattice method coupled with the leading edge suction analogy for the 50 deg., 60 deg. and 70 deg. delta wings. The results obtained from this analysis agree qualitatively with the experimental results.
Author
Delta Wings; Leading Edge Flaps; Lift Drag Ratio; Sweepback; Vortex Flaps; Angles (Geometry); Wind Tunnel Tests; Low Speed Stability

19990028430 Queen Mary and Westfield Coll., Dept. of Engineering, London, UK
A note on the potential contribution of wing-body interference drag to the total drag of an aircraft
Bernstein, L., Queen Mary and Westfield Coll., UK; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 417-420; In English; See also 19990028427
Report No.(s): Paper-2351; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

The implications of a rise in the pressure drag of a wing near its junction with a fuselage are examined. Based on some data measured for a swept-wing-plate junction, in which the wing was of NACA 0015-profile normal to its leading edge and swept back at 20 degrees, it is found that there is a potential penalty of order 1% of the total aircraft drag in the cruise condition.
Author
Aerodynamic Drag; Body-Wing Configurations; Fuselages; Interactional Aerodynamics; Pressure Drag; Swept Wings; Interference Drag

19990028444 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Synchronous Averaging of Helicopter Tail Rotor Gearbox Vibration: Phase Reference Considerations
Blunt, D. M.; Oct. 1998; 56p; In English
Report No.(s): AD-A360600; DSTO-TR-0739; DODA-AR-010-666; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Synchronous averaging requires an accurate phase reference (tachometer) signal. In helicopter transmissions, such a signal can usually be obtained or derived from an engine or main rotor gearbox accessory, but is not as readily available for the tail rotor gearbox. This report examines whether a separate tail rotor gearbox phase reference signal is necessary by investigating the relative jitter, due to dynamic tail drive shaft twist, between phase reference signals obtained from the main and tail rotor gearboxes in a S7OA-9 Black Hawk helicopter.
DTIC
Helicopter Tail Rotors; Structural Vibration; Helicopter Propeller Drive

19990028445 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Stress and Strain Estimation of Notches in Aircraft Structures
Jones, R.; Knapp, M.; Price, J.; Molent, L.; Oct. 1998; 31p; In English
Report No.(s): AD-A360599; DSTO-GD-0196; COE-SM-98-01; DODA-AR-010-652; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To maintain the continued airworthiness of military aircraft it is essential that the fatigue behavior of components subjected to complex multi-axial stress conditions be both understood and predicted. This topic is extremely complex. Numerous fatigue failure criteria ranging from the purely empirical to the theoretical have been proposed. These criteria rely on the estimation of stress and strain at fatigue critical locations. This interim report focused on possible approaches which may be applicable to both low and high-cycle fatigue regimes. It discusses the relative advantages of the Neuber and the Glinka methods for calculating localized notch strains as compared to the results from finite element analysis.
DTIC
Notches; Aircraft Reliability; Aircraft Structures; Axial Stress; Finite Element Method; Fatigue Life

19990028450 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
The Yield Behaviour of a Structural Adhesive Under Complex Loading
Ignjatovic, Mladen; Chalkley, Peter; Wang, Chun; Sep. 1998; 41p; In English
Report No.(s): AD-A360569; DSTO-TR-0728; DODA-AR-010-646; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recent developments in bonded composite repair technology at the Aeronautical and Maritime Research Laboratory (AMRL) have been in the area of repairs to curved surfaces, e.g. the proposed repairs to the F/A-18 aileron hinge and the F/A-18 bulkhead crotch region. Bonded composite repairs to curved surfaces induce through-thickness stresses as well as shear stresses in the adhesive. The yield behaviour of AMRLs most common repair adhesive - FM73 - has not been investigated under such conditions of combined loading. Reported herein is a yield function for the repair adhesive FM73, based upon the Modified Drucker-Prager/Cap Plasticity model. This yield function was selected based on experiments on a test specimen subjected to a range of combined stress states. A finite element (FE) analysis of test specimen (Iosipescu test specimen modified for adhesives) was carried out to establish its validity for obtaining data.
DTIC
Airframes; Adhesive Bonding; Aircraft Maintenance; Bonded Joints; F-18 Aircraft; Load Distribution (Forces); Finite Element Method; Shear Stress

19990028567 NASA Lewis Research Center, Cleveland, OH USA
Comparison of cooler arrangements for the thermal management system of an atmospheric science remotely piloted vehicle
Maldonado, Jaime J., NASA Lewis Research Center, USA; Bents, David J., NASA Lewis Research Center, USA; JANNAF Air-breathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 89-98; In English; See also 19990028559; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The design and comparison of two cooler arrangements for the thermal management system of a high altitude atmospheric science remotely piloted vehicle have been completed. The propulsion system of this vehicle consist of a triply turbocharged Rotax 912 delivering 80 HP at 80,000 ft. under hot-day conditions. The thermal management system needs to dissipate heat from the internal combustion engine, as well as the compression heat generated in the turbochargers. to predict the performance and estimate the weight of the thermal management system, a heat exchanger design and analysis tool called LACEX has been used. The intermediate cooling loop arrangement has the advantage of easier installation and packaging in the aircraft structure, but is heavier than the direct air-to-air arrangement. Likewise, the drag produced by the intermediate cooling loop arrangement is greater than the direct air-to-air arrangement. Considering the importance of minimizing weight and drag, the direct air-to-air system appears to be a better arrangement for this type of vehicle.
Author
Coolers; Heat Exchangers; High Altitude; Internal Combustion Engines; Remotely Piloted Vehicles; Systems Engineering; Temperature Control; Propulsion System Configurations

19990028762 NASA Langley Research Center, Hampton, VA USA
Active Vertical Tail Buffeting Alleviation on an F/A-18 Model in a Wind Tunnel
Moses, Robert W., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 821-830; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A 1/6-scale F-18 wind-tunnel model was tested in the Transonic Dynamics Tunnel at the NASA Langley Research Center as part of the Actively Controlled Response of Buffet-Affected Tails (ACROBAT) program to assess the use of active controls in reducing vertical tail buffeting. The starboard vertical tail was equipped with an active rudder and other aerodynamic devices, and the port vertical tail was equipped with piezoelectric actuators. The tunnel conditions were atmospheric air at a dynamic pres-

sure of 14 psf. by using single-input-single-output control laws at gains well below the physical limits of the control effectors, the power spectral density of the root strains at the frequency of the first bending mode of the vertical tail was reduced by as much as 60 percent up to angles of attack of 37 degrees. Root mean square (RMS) values of root strain were reduced by as much as 19 percent. Stability margins indicate that a constant gain setting in the control law may be used throughout the range of angle of attack tested.
Author
Active Control; Buffeting; Scale Models; SISO (Control Systems); Tail Assemblies; Wind Tunnel Models; Control Equipment; Power Spectra

19990028765 Interpacific Technology, Inc., Oakland, CA USA
Design of Visually Inspectable Fuselage Skin Repairs
Chen, P. C., Interpacific Technology, Inc., USA; Roderick, D. B., Interpacific Technology, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 853-862; In English; See also 19990028721
Contract(s)/Grant(s): DTFA03-94-C-00005; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A new approach which uses the concept of visually inspectable repairs has been employed to design fuselage skin repairs. A visually inspectable fuselage skin repair is one for which a crack emanating from the fastener hole with the largest fastener load in the skin is visually inspectable from the most accessible side of the skin, thus reducing the reliance on nondestructive inspection (NDI) techniques to detect cracks prior to catastrophic failure. This paper presents the guidelines used in designing visually inspectable repairs for fuselage skins with different damage configurations, i.e., skin with a circular hole, skin with a rectangular cutout, and skin with a crack. It discusses why a skin repair is or is not visually inspectable, how a nonvisually inspectable skin repair can be made visually inspectable, and what guidelines need to be followed to design a visually inspectable fuselage skin repair.
Author
Skin (Structural Member); Fuselages; Inspection; Visual Observation; Structural Analysis

19990032180 Sandia National Labs., FAA Airworthiness Assurance NDI Validation Center, Albuquerque, NM USA
Detection Reliability for Small Cracks Beneath Rivet Heads Using Eddy-Current Nondestructive Inspection Techniques *Final Report*
Spencer, Floyd W.; Dec. 1998; 55p; In English
Report No.(s): AD-A359396; DOT/FAA/AR-97/73; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Advanced inspection technology that is emerging from the laboratory is generally far superior to the less capable systems around which aircraft inspections are designed. In light of the very conservative nature of these inspection designs, it is apparent that today's advanced technology is being employed at only a fraction of its full potential. In order to assess the full potential of advanced eddy-current inspection technology on representative aircraft applications, the FAA's Airworthiness Assurance Nondestructive Inspection Validation Center (AANC) was tasked to assess the full capability of several advanced systems. The task involved inspections of several rivet skin splices-representative of actual aircraft structure-containing cracks ranging from 0.040-, 0.060-, and 0.080-inch standards, and thresholds were set to the lowest reasonable level for the particular system. The results demonstrated that some of the systems were able to reliably detect cracks as small as 0.040 inch with false call rates remained less than 1%.
DTIC
Nondestructive Tests; Rivets; Cracks; Inspection; Aircraft Maintenance

19990032205 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia
Variational Bounds for the Equivalent Spring Constants for Bonded Repairs
Chalkley, Peter; Rose, L. R.; Sep. 1998; 41p; In English
Report No.(s): AD-A360611; DSTO-RR-0139; DODA-AR-010-644; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Variational bounds, both upper and lower, are found for the equivalent spring constant of a double-strap joint which represents a sub-element of bonded repairs to cracked structure. Conservative estimates of the equivalent spring constant, needed for accurate design, are obtained from variational analyses of the joint. Estimates from various analytical models of varying level of approximation were obtained. Simpler expressions for the spring constant resulted from relaxing certain assumptions, however, the theoretical guarantee of a true upper or lower bound was lost Spring constant estimates were compared with finite element model

results and so the fidelity of the variational bounds, specially for the simplified analyses, could be established. An improved formula is proposed for use in design procedures in RAAF C5033.
DTIC
Aircraft Maintenance; Mathematical Models; Bonded Joints; Attack Aircraft

19990032232 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Development of a biaxial test facility for structural evaluation of aircraft fuselage panels
Roach, D., Department of Energy, USA; Walkington, P., Department of Energy, USA; Rice, T., Department of Energy, USA; Mar. 31, 1998; 6p; In English; SEM Experimental and Applied Mechanics, 1998, USA
Report No.(s): DE98-004256; SAND-98-0696C; CONF-980627; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The number of commercial airframes exceeding twenty years of service continues to grow. An unavoidable by-product of aircraft use is that crack and corrosion flaws develop throughout the aircraft's skin and substructure elements. Economic barriers to the purchase of new aircraft have created an aging aircraft fleet and placed even greater demands on efficient and safe repair methods. Composite doublers, or repair patches, provide an innovative repair technique which can enhance the way aircraft are maintained. Instead of riveting multiple steel or aluminum plates to facilitate an aircraft repair, it is now possible to bond a single Boron-Epoxy composite doubler to the damaged structure. The composite doubler repair process produces both engineering and economic benefits. The FAA's Airworthiness Assurance Center at Sandia National Labs completed a project to introduce composite doubler repair technology to the commercial aircraft industry. This paper focuses on a specialized structural test facility which was developed to evaluate the performance of composite doublers on actual aircraft structure. The facility can subject an aircraft fuselage section to a combined load environment of pressure (hoop stress) and axial, or longitudinal, stress. The tests simulate maximum cabin pressure loads and use a computerized feedback system to maintain the proper ratio between hoop and axial loads. Through the use of this full-scale test facility it was possible to: (1) assess general composite doubler response in representative flight load scenarios, and (2) verify the design and analysis approaches as applied to an L-1011 door corner repair.
NTIS
Test Facilities; Composite Materials; Fabrication; Fuselages; Evaluation; Aircraft Structures; Commercial Aircraft

19990032410 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia
Service History of the F-111 Wing Pivot Fitting Upper Surface Boron/Epoxy Doublers
Chalkley, Peter; Geddes, Rowan; Sep. 1998; 23p; In English
Report No.(s): AD-A360610; DSTO-TN-0168; DODA-AR-010-643; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Several of the boron/epoxy doublers applied to upper surface of RAAF F-111C wing- pivot-fittings (WFFs) have disbonded. Based on RAAF records, a total of seven wings (out of forty to which doublers have been applied) have confirmed disbonds: A15-3, A15-5, A15-10, A15-14, A15-19, A15-20 and A15-284R. Most of the disbonds are forming in the smaller forward doubler (five confirmed) although three aft doublers have also disbonded. This report documents the service history of all doublers applied to RAAF F-111Cs. The current investigation suggests that disbonds in the boron/epoxy doublers on the upper surface of F-111 WFFs are forming within 1000 AFHRS service. However, infrequent inspections of the doublers make a precise determination difficult issues such as the use of external wing tanks on some aircraft (especially RF111C's), disbond initiation sites and below tolerance wing skin thicknesses are investigated.
DTIC
Aircraft Maintenance; Bonded Joints; Tilt Wing Aircraft; Services; Service Life; Boron-Epoxy Composites

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.

19990028488 Toledo Univ., OH USA
A Java-Enabled Interactive Graphical Gas Turbine Propulsion System Simulator
Reed, John A., Toledo Univ., USA; Afjeh, Abdollah A., Toledo Univ., USA; 1997; 9p; In English
Contract(s)/Grant(s): NAG3-1750
Report No.(s): AIAA Paper 97-0233; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper describes a gas turbine simulation system which utilizes the newly developed Java language environment software system. The system provides an interactive graphical environment which allows the quick and efficient construction and analysis of arbitrary gas turbine propulsion systems. The simulation system couples a graphical user interface, developed using the Java Abstract Window Toolkit, and a transient, space- averaged, aero-thermodynamic gas turbine analysis method, both entirely coded in the Java language. The combined package provides analytical, graphical and data management tools which allow the user to construct and control engine simulations by manipulating graphical objects on the computer display screen. Distributed simulations, including parallel processing and distributed database access across the Internet and World-Wide Web (WWW), are made possible through services provided by the Java environment.
Author
Gas Turbines; Graphical User Interface; Internets; Java (Programming Language); Propulsion; Propulsion System Performance; Simulation; World Wide Web; Aerothermodynamics; Propulsion System Configurations

19990028507 General Electric Co., Aircraft Engines, Cincinnati, OH USA
Parallel 3D Multi-Stage Simulation of a Turbofan Engine
Turner, Mark G., General Electric Co., USA; Topp, David A., General Electric Co., USA; 1998; 10p; In English; High Performance Computing and Communication (HPCC)/Computational AeroSsience (CAS) Workshop, USA; Sponsored by NASA Lewis Research Center, USA
Contract(s)/Grant(s): RTOP 509-10-11; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A 3D multistage simulation of each component of a modern GE Turbofan engine has been made. An axisymmetric view of this engine is presented in the document. This includes a fan, booster rig, high pressure compressor rig, high pressure turbine rig and a low pressure turbine rig. In the near future, all components will be run in a single calculation for a solution of 49 blade rows. The simulation exploits the use of parallel computations by using two levels of parallelism. Each blade row is run in parallel and each blade row grid is decomposed into several domains and run in parallel. 20 processors are used for the 4 blade row analysis. The average passage approach developed by John Adamczyk at NASA Lewis Research Center has been further developed and parallelized. This is APNASA Version A. It is a Navier-Stokes solver using a 4-stage explicit Runge-Kutta time marching scheme with variable time steps and residual smoothing for convergence acceleration. It has an implicit K-E turbulence model which uses an ADI solver to factor the matrix. Between 50 and 100 explicit time steps are solved before a blade row body force is calculated and exchanged with the other blade rows. This outer iteration has been coined a ”flip.” Efforts have been made to make the solver linearly scaleable with the number of blade rows. Enough flips are run (between 50 and 200) so the solution in the entire machine is not changing. The K-E equations are generally solved every other explicit time step. One of the key requirements in the development of the parallel code was to make the parallel solution exactly (bit for bit) match the serial solution. This has helped isolate many small parallel bugs and guarantee the parallelization was done correctly. The domain decomposition is done only in the axial direction since the number of points axially is much larger than the other two directions. This code uses MPI for message passing. The parallel speed up of the solver portion (no 1/0 or body force calculation) for a grid which has 227 points axially.
Derived from text
Convergence; Navier-Stokes Equation; Runge-Kutta Method; Simulation; Turbofan Engines; Parallel Processing (Computers); Computational Fluid Dynamics; K-Epsilon Turbulence Model

19990028565 NASA Lewis Research Center, Cleveland, OH USA

Fuel injector patternation evaluation in advanced liquid-fueled, high pressure, gas turbine combustors, using nonintrusive optical diagnostic techniques

Locke, R. J., NYMA, Inc., USA; Hicks, Y. R., NASA Lewis Research Center, USA; Anderson, R. C., NASA Lewis Research Center, USA; Zaller, M. M., NASA Lewis Research Center, USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 61-71; In English; See also 19990028559; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

Planar laser-induced fluorescence (PLIF) imaging and planar Mie scattering are used to examine the fuel distribution pattern (patternation) for advanced fuel injector concepts in kerosene burning, high pressure gas turbine combustors. Three diverse fuel injector concepts for aerospace applications were investigated under a broad range of operating conditions. Fuel PLIF patternation results are contrasted with those obtained by planar Mie scattering. Further comparison is also made for one injector with data obtained through phase Doppler measurements. Differences in spray patterns for diverse conditions and fuel injector configurations are readily discernible. An examination of the data has shown that a direct determination of the fuel spray angle at realistic conditions is also possible. The results obtained in this study demonstrate the applicability and usefulness of these nonintrusive optical techniques for investigating fuel spray patternation under actual combustor conditions.

Author

Combustion Chambers; Fuel Injection; Imaging Techniques; Injectors; Kerosene; Laser Induced Fluorescence; Mie Scattering; Gas Turbine Engines; Distribution (Property)

19990028568 Pratt and Whitney Aircraft, West Palm Beach, FL USA

Applications of endothermic research technology to the high speed civil transport

Glickstein, M. R., Pratt and Whitney Aircraft, USA; Spadaccini, L. J., United Technologies Research Center, USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 99-106; In English; See also 19990028559

Contract(s)/Grant(s): NAS3-27397; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The success of strategies for controlling emissions and enhancing performance in High Speed Research applications may be increased by more effective utilization of the heat sink afforded by the fuel in the vehicle thermal management system. This study quantifies the potential benefits associated with the use of supercritical preheating and endothermic cracking of jet fuel prior to combustion to enhance the thermal management capabilities of the propulsion systems in the High Speed Civil Transport (HSCT). A fuel-cooled thermal management system, consisting of plate-fin heat exchangers and a small auxiliary compressor, is defined for the HSCT, integrated with the engine, and an assessment of the effect on engine performance, weight, and operating cost is performed. The analysis indicates significant savings due a projected improvement in fuel economy, and the potential for additional benefit if the cycle is modified to take full advantage of all the heat sink available in the fuel.

Author

Endothermic Fuels; Endothermic Reactions; Fuel Combustion; Fuel Systems; Heat Sinks; Jet Engine Fuels; Propulsion System Configurations; Heat Exchangers; Supersonic Commercial Air Transport; Turbine Engines; Cooling Systems

19990028821 Stress Technology, Inc., Rochester, NY USA

Engine Health Monitoring System for Advanced Diagnostic Monitoring for Gas Turbine Engines ***Final Report, 13 Nov. 1995 - 20 Feb. 1998***

Roemer, Michael J.; Feb. 1998; 91p; In English

Contract(s)/Grant(s): F33615-95-C-2567; AF Proj. 3005

Report No.(s): AD-A359658; AFRL-PR-WP-TR-1998-2120; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A prototype USAF engine health management (EHM) system was developed and ground tested during this Phase II SBIR program. The EHM system is capable of real-time mechanical monitoring and diagnostics, aero-thermal performance monitoring and diagnostics, and ”engine signature” based life accumulation. For the first time, state-of-the-art anomaly detection, monitoring, diagnosis and advanced life prediction analysis were integrated together in a single real-time engine health monitoring system. Additionally, the EHM system was developed to assist the 2-level maintenance concept and IHPTET initiatives.

DTIC

Engine Monitoring Instruments; Systems Health Monitoring; Gas Turbine Engines; Real Time Operation

19990032063 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Verification of Creep Performance of a Ceramic Gas Turbine Blade
Lin, H. T., Department of Energy, USA; Becher, P. F., Department of Energy, USA; Ferber, M. K., Department of Energy, USA; Parthasarathy, V., Department of Energy, USA; Mar. 31, 1998; 6p; In English; 2nd; Science of Engineering Ceramics, USA
Report No.(s): DE98-005762; ORNL/CP-97457; CONF-980912; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Tensile creep tests were carried out on a Norton NT164 silicon nitride ceramic turbine blade containing 4 wt.% Y2O3 sintering additive at 1,370 C in air under selected stress levels. The objective of this study was to measure the creep properties of test specimens extracted from a complex shaped ceramic gas turbine blade to verify the response of actual components. The creep results indicated that specimens from both the airfoil and dovetail sections exhibited creep rates that were about 4 to 100 times higher than those obtained from both the buttonhead and dogbone creep specimens machined from the developmental billets fabricated with the same composition and processing procedures. Electron microscopy analyses suggested that high creep rates and short lifetimes observed in specimens extracted from the turbine blade resulted from a higher glassy phase(s) content and smaller number density of elongated grain microstructure. Silicon nitride ceramics with an in situ reinforced elongated microstructure have been the primary candidates for both advanced automotive and land-based gas turbine engine applications.
NTIS
Tensile Creep; Creep Tests; Turbine Blades; Silicon Nitrides; Ceramics

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also 14 Ground Support Systems and Facilities (Space).

19990028346 NASA Goddard Space Flight Center, Greenbelt, MD USA
Refurbishment and Automation of Thermal Vacuum Facilities at NASA/GSFC
Dunn, Jamie, NASA Goddard Space Flight Center, USA; Gomez, Carlos, NASA Goddard Space Flight Center, USA; Donohue, John, NASA Goddard Space Flight Center, USA; Johnson, Chris, ManTech Systems Engineering Corp., USA; Palmer, John, ManTech Systems Engineering Corp., USA; Sushon, Janet, ManTech Systems Engineering Corp., USA; 1998; In English; 20th; Space Simulation, 27-29 Oct. 1998, USA
Report No.(s): NASA/CR-1998-208598; NAS 1.26:208598; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The thermal vacuum facilities located at the Goddard Space Flight Center (GSFC) have supported both manned and unmanned space flight since the 1960s. Of the eleven facilities, currently ten of the systems are scheduled for refurbishment or replacement as part of a five-year implementation. Expected return on investment includes the reduction in test schedules, improvements in safety of facility operations, and reduction in the personnel support required for a test. Additionally, GSFC will become a global resource renowned for expertise in thermal engineering, mechanical engineering, and for the automation of thermal vacuum facilities and tests. Automation of the thermal vacuum facilities includes the utilization of Programmable Logic Controllers (PLCs), the use of Supervisory Control and Data Acquisition (SCADA) systems, and the development of a centralized Test Data Management System. These components allow the computer control and automation of mechanical components such as valves and pumps. The project of refurbishment and automation began in 1996 and has resulted in complete computer control of one facility (Facility 281), and the integration of electronically controlled devices and PLCs in multiple others.
Author
Thermal Vacuum Tests; Systems Engineering; Data Management; Management Systems; Data Acquisition

19990028431 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany
Operational experience and test results in the adaptive test section of the DLR transonic tunnel
Holst, H., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Bock, K-W., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Lorenz-Meyer, W., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Oberdieck, F., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hermes, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 421-428; In English; Windtunnel and Windtunnel Testing Techniques CEAS Forum, Apr. 1997, Cambridge, UK; See also 19990028427
Report No.(s): Paper-2281; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

The transonic facility of DLR Goettingen (TWG) has been modernized with respect to an improved flow quality and flow simulation, as well as to the logistics of exchangeable test sections, operational reliability and productivity. It is presently equipped with a Laval nozzle for supersonic flow measurements, a perforated test section (6% open, 60 deg. slanted holes) for transonic measurements, and a two-dimensional adaptive test section for subsonic measurements. The latter can perform two-dimensional adaptive tests on wing profiles, using the Cauchy integral formula for wall adaptation, as well as two-dimensional wall adaptation for three-dimensional models, utilising the Wedemeyer/Lamarche procedure, also known as the VKI method. For both cases, it is shown that the wall adaptation was successful. The 3D force results compare quite well to test results from the perforated test section, as well as to nominally interference-free results. The pressure distribution from the wing profile tests compare quite well to theoretical calculations. In the course of windtunnel modernization, the transonic facility of DLR Goettingen has been equipped with the new software system DeAs for data acquisition and control of experimental facilities. In this environment the wall adaptation programs had to be implemented. Before adjusting the computed wall shape, it has to be controlled in the loop for sufficient accuracy and tolerable bending stresses. A simplified finite element method - also taking into account the pressure loads at the wall - is used for this purpose. The simplified approach has been checked against more detailed computations using ANSYS and NASTRAN.
Author
Finite Element Method; Pressure Distribution; Supersonic Flow; Transonic Wind Tunnels; Wind Tunnel Walls; Slotted Wind Tunnels; Wind Tunnel Calibration; Cauchy Integral Formula

19990028432 Office National d'Etudes et de Recherches Aerospatiales, Modane, France
On the use of large scale windtunnel models
Giacchetto, A., Office National d'Etudes et de Recherches Aerospatiales, France; The Aeronautical Journal; November 1997; Volume 101, No. 1009, pp. 429-437; In English; Windtunnel Testing Technique CEAS Forum, Apr. 1997, Cambridge, UK; See also 19990028427
Report No.(s): Paper-2284; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ), Hardcopy, Microfiche

The use of large scale windtunnel models offers considerable advantages to an experimenter: (1) the possibility of obtaining high Reynolds number, certainly significant and sometimes equal to that in flight, for moderate stagnation pressures; (2) an accurate representation of geometric elements, i.e. good form similitude (it is necessary to emphasise the importance of being very thorough in this area); (3) large internal volume, which enable numerous transducers to be implanted, ambitious experimental devices and means of remote control of model motorization; and (4) test conditions remain those corresponding to industrial manufacturing methods and so avoid problems related to extreme miniaturization. Additionally, there exist some test conditions for which scale reduction is limited or even impossible; for example, because of physical phenomena, limitation in industrial methods of miniaturisation, or quite simply because the subject is itself the flying object. These conditions are applicable to all tests whether industrial or research. They are especially true for industrial tests where these concern important decisions. They are also true for research tests whenever they need to be sufficiently close to flight reality. Wind-tunnels are always a means to reduce the costs and risks of aeronautical project developments. The risk taken in extrapolating from windtunnel tests to flight are lower when the test is more realistic and this gives a clear advantage to tests on large sized models.
Author
High Reynolds Number; Scale Models; Wind Tunnel Models; Wind Tunnels; External Store Separation; Wind Tunnel Tests

12
ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see 91 Lunar and Planetary Exploration.

19990028634 Office of Science and Technology, Washington, DC USA
Interagency Report on Orbital Debris
November 1995; 90p; In English; Original contains color illustrations
Report No.(s): LC-95-72164; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Taking into consideration the results of the National Research Council orbital debris technical assessment study funded by the National Aeronautics and Space Administration, an Interagency Working Group under the direction of the Office of Science and Technology Policy and the National Security Council revised and updated the 1989 Report on Orbital Debris. This 1995 Report contains an up-to-date portrait of our measurement, modeling, and mitigation efforts and a set of recommendations

outlining specific steps we should pursue, both domestically and internationally, to minimize the potential hazards posed by orbital debris.
Author
Space Debris; Flight Hazards; Space Flight; Low Earth Orbits; Earth Orbital Environments; Geosynchronous Orbits

19990032023 NASA Langley Research Center, Hampton, VA USA
Departure Energies, Trip Times and Entry Speeds for Human Mars Missions
Munk, Michelle M., NASA Langley Research Center, USA; 1999; In English; Space Flight Mechanics, 7-10 Feb. 1999, Breckenridge, CO, USA; Sponsored by American Astronautical Society, USA
Report No.(s): AAS Paper 99-103; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The study examines how the mission design variables departure energy, entry speed, and trip time vary for round-trip conjunction-class Mars missions. These three parameters must be balanced in order to produce a mission that is acceptable in terms of mass, cost, and risk. For the analysis, a simple, massless- planet trajectory program was employed. The premise of this work is that if the trans-Mars and trans-Earth injection stages are designed for the most stringent opportunity in the energy cycle, then there is extra energy capability in the ”easier” opportunities which can be used to decrease the planetary entry speed, or shorten the trip time. Both of these effects are desirable for a human exploration program.
Author
Design Analysis; Atmospheric Entry; Trajectories; Mission Planning

19990032101 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Spacecraft Emergency Response System (SERS) for Autonomous Mission Operations
Breed, Julia, NASA Goddard Space Flight Center, USA; Chu, Kai-Dee, Global Science and Technology, Inc., USA; Baker, Paul, Global Science and Technology, Inc., USA; Starr, Cynthia, Global Science and Technology, Inc., USA; Fox, Jeffrey, Pacific Northwest National Lab., USA; Baitinger, Mick, NextGen Solutions, Inc., USA; [1998]; In English; 3rd; Reducing the Cost of Operation, USA
Contract(s)/Grant(s): NAS5-32982; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Today, most mission operations are geared toward lowering cost through unmanned operations. 7-day/24-hour operations are reduced to either 5-day/8-hour operations or become totally autonomous, especially for deep-space missions. Proper and effective notification during a spacecraft emergency could mean success or failure for an entire mission. The Spacecraft Emergency Response System (SERS) is a tool designed for autonomous mission operations. The SERS automatically contacts on-call personnel as needed when crises occur, either on-board the spacecraft or within the automated ground systems. Plus, the SERS provides a group-ware solution to facilitate the work of the person(s) contacted. The SERS is independent of the spacecraft’s automated ground system. It receives and catalogues reports for various ground system components in near real-time. Then, based on easily configurable parameters, the SERS determines whom, if anyone, should be alerted. Alerts may be issued via Sky-Tel 2-way pager, Telehony, or e-mail. The alerted personnel can then review and respond to the spacecraft anomalies through the Netscape Internet Web Browser, or directly review and respond from the Sky-Tel 2-way pager.
Author
Automatic Control; Emergencies; Real Time Operation; Internets; Autonomy

19990032431 Office National d’Etudes et de Recherches Aerospatiales, Derts, Toulouse France
Study of Species Produced by Atomic Oxygen Impact on Polymer-Resin Materials using a Mass Spectrometry Method *Final Report*
Pallous, A.; Oct. 1998; 22p; In English
Contract(s)/Grant(s): F61775-98-WE053
Report No.(s): AD-A360511; SPC-98-4033; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking CERT-ONERAIDERTS as follows: The contractor will investigate the effects of atomic oxygen (AO) on polymer-resin materials. Experimental conditions will simulate the AO environment of low-Earth orbit. Results will be analyzed for a completely neutral AO beam.
DTIC
Oxygen; Spacecraft Components; Research; Oxygen Atoms; Aerospace Vehicles; Aerospace Environments

19990032587 NASA Johnson Space Center, Houston, TX USA

1998 Mars Missions Science Briefing

Nov. 13, 1998; In English; Videotape: 58 min. 30 sec. playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

NASA executives gathered together for an interview to discuss the 1998 Mars Mission. A simulated overview of the Lander Mission is presented. Also presented are views of pre-launch activities, countdown, and launch of the spacecraft, burnouts of the first, second, and third engines, and the probe separating from the spacecraft. During this mission the Lander performs in situ investigations that address the science theme ”Volatiles and Climate History” on Mars. The purpose of this mission is to study the following: climate; life; water; carbon dioxide; and dust particles.

CASI

Mars (Planet); Mars Atmosphere; Mars Environment; Mars Sample Return Missions; Mars Polar Lander

14
GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment; e.g., mobile transporters; and simulators. For related information see also 09 Research and Support Facilities (Air).

19990032086 NASA Lewis Research Center, Cleveland, OH USA

Telescience Operations on International Space Station

Schubert, Kathleen E., NASA Lewis Research Center, USA; February 1999; 10p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 479-85-01

Report No.(s): NASA/TM-1999-208910; NAS 1.15:208910; AIAA Paper 99-0319; E-11525; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper describes the concept of telescience operations for the International Space Station (ISS). The extended duration microgravity environment of the ISS will enable microgravity science research to enter into a new era of increased scientific and technological data return. The National Aeronautics and Space Administration (NASA) has a vision of distributed ground operations which enables the Principal Investigator direct interaction with his/her on-board experiment from his/her home location. This is the concept of telescience and is essential for maximizing the use of the long duration science environment that ISS provides. The goal of telescience is to provide the capability to fully tele-operate an experiment from any ground location in such a way as to increase the amount and quality of scientific and technological data return and decrease the operations cost of an individual experiment relative to the era of Space Shuttle experiments. This paper also describes the NASA Lewis Research Center (LERC) implementation approach for the LERC Telescience Support Center (TSC) and Principal Investigator Science Operations Sites (SOS) which will fully meet the concept of telescience as prescribed by the Agency.

Author

International Space Station; Space Shuttles; Ground Operational Support System; Communication Networks; NASA Programs

15
LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also 20 Spacecraft Propulsion and Power.

19990028385 NASA Marshall Space Flight Center, Huntsville, AL USA

A Strategy for Integrating a Large Finite Element Model Using MSC NASTRAN/PATRAN: X-33 Lessons Learned

McGhee, D. S., NASA Marshall Space Flight Center, USA; March 1999; 16p; In English

Report No.(s): NASA/TM-1999-209201; NAS 1.15:209201; M-917; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The X-33 vehicle is an advanced technology demonstrator sponsored by NASA. For the past 3 years the Structural Dynamics and Loads Branch of NASA’s Marshall Space Flight Center has had the task of integrating the X-33 vehicle structural finite element model. In that time, five versions of the integrated vehicle model have been produced and a strategy has evolved that would benefit anyone given the task of integrating structural finite element models that have been generated by various modelers and companies. The strategy that has been presented here consists of six decisions that need to be made: purpose of models, units,

common materials list, model numbering, interface control, and archive format. This strategy has been proven and expanded from experience on the X-33 vehicle.
Author
X-33 Reusable Launch Vehicle; Finite Element Method; Models; Nastran

19990032573 NASA Johnson Space Center, Houston, TX USA
Delta II Stardust Pre-Launch Press
Feb. 05, 1999; In English; Videotape: 1 hour 2 min. 13 sec. playing time. in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

Coverage of the press conference for the Stardust Launch Mission is presented. The objective of this press conference is to identify and explain the purpose of the Stardust Mission. A question and answer phase followed the mission objective. Also presented was an animation of the exact mission highlights, which included the orbit of the probe, collection of dust materials and space particles, and deployment of the solar panels.
CASI
Conferences; Return to Earth Space Flight; Stardust Mission; Space Probes

19990032574 NASA Johnson Space Center, Houston, TX USA
Delta II Stardust Mission Briefing
Jan. 13, 1999; In English; Videotape: 1 hour 3 min. playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

An overview of the Stardust Mission is shown. NASA personnel is seen discussing and explaining the path of the probe. An animated clip is presented to demonstrate how the probe will collect interstellar dust materials, and space particles by using an aerogel. The animation also described the process by which the probe will take photographs of the comets from the on board camera. The dust samples and the photographs will be analyzed in order to learn more about interstellar materials.
CASI
Conferences; Stardust Mission; Space Probes; Cosmic Dust; Space Debris

19990032575 NASA Johnson Space Center, Houston, TX USA
Stardust Launch Coverage
Feb. 07, 1998; In English; Videotape: 1 hour playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The ground crew is shown building the Stardust launch vehicle. Important visual images include loading the launch vehicle, erecting the Solid Rocket Boosters, the countdown and launch of the Delta Rocket, separation of the four Boosters, and the main engine cut off. The cut off of the main engine marks the beginning of the second stage engine. During its circular path, Stardust collects interstellar and cometary dust from the Wild 2 comet.
CASI
Launch Vehicles; Interstellar Matter; Cosmic Dust; NASA Space Programs; Mars Sample Return Missions; Wild 2 Comet; Stardust Mission

16
SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. for related information see also 03 Air Transportation and Safety and 18 Spacecraft Design, Testing and Performance. For space suits see 54 Man/System Technology and Life Support

19990031949 NASA Kennedy Space Center, Cocoa Beach, FL USA
Debris/Ice/TPS Assessment and Integrated Photographic Analysis of Shuttle Mission STS-88 ***Final Report, 2-17 Dec. 1998***
Katnik, Gregory N., NASA Kennedy Space Center, USA; March 1999; 128p; In English; Original contains color illustrations
Report No.(s): NASA/TM-1999-208542; NAS 1.15:208542; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A debris/ice/thermal protection system assessment and integrated photographic analysis was conducted for Shuttle mission STS-88. Debris inspections of the flight elements and launch pad were performed before and after launch. Icing conditions on the External Tank were assessed by the use of computer programs and infrared scanned data during cryogenic loading of the vehicle, followed by on-pad visual inspection. High speed photography of the launch was analyzed to identify ice/debris sources

and evaluate potential vehicle damage and/or in-flight anomalies. This report documents the ice/debris/thermal protection system conditions and integrated photographic analysis of Space Shuttle mission STS-88 and the resulting effect on the Space Shuttle Program.
Author
Space Transportation System Flights; Ice Formation; Debris; Inspection; Visual Observation; Spacecraft Launching; Photographs

19990032557 NASA Marshall Space Flight Center, Huntsville, AL USA
General Public Space Travel and Tourism, Volume 1, Executive Summary
ONeil, Daniel, Compiler, NASA Marshall Space Flight Center, USA; Bekey, Ivan, NASA, USA; Mankins, John, NASA, USA; Rogers, Thomas F., Space Transportation Association, USA; Stallmer, Eric W., Space Transportation Association, USA; March 1998; 40p; In English; Summary of a Space Act Agreement Study, 19-21 Feb. 1997, Washington, DC, USA
Report No.(s): NASA/NP-1998-03-11-MSFC/VOL1; NAS 1.83:03-11-MSFC/VOL1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Travel and tourism is one of the world's largest businesses. Its gross revenues exceed $400 billion per year in the U.S. alone, and it is our second largest employer. U.S. private sector business revenues in the space information area now approximate $10 billion per year, and are increasing rapidly. Not so in the human spaceflight area. After spending $100s of billions (1998 dollars) in public funds thereon, and continuing to spend over $5 billion per year, the government is still the only customer for human spaceflight goods and services. Serious and detailed consideration was first given to the possibility of space being opened up to trips by the general public three decades ago, and some initial attempts to do so were made a dozen years ago. But the difficulties were great and the Challenger disaster put an end to them. In recent years professional space tourism studies have been conducted in the UK, Germany and, especially, Japan. In the U.S., technological progress has been pronounced; we have had nearly a decade's experience in seeing our astronauts travel to-from low Earth orbit (LEO) safely, and we expect to commence assembly of a LEO space station housing a half-dozen people this year. Too, NASA and our space industry now have new and promising space transportation development programs underway, especially the X-33 and X-34 programs, and some related, further generation, basic technology development programs. and five private companies are also working on the design of new surface - LEO vehicles. The first professional space tourism market studies have been conducted in several countries in the past few years, especially in Japan and here. The U.S. study makes it clear that, conceptually, tens of millions of us would like to take a trip to space if we could do so with reasonable safety, comfort and reliability, and at an acceptable price. Initial businesses will address the desires of those willing to pay a greater price and accept a greater risk. A two-year cooperative Space Act agreement study has been conducted by our National Aeronautics and Space Administration and the Space Transportation Association. It was conducted by NASA and STA study leaders drawing upon the competence, experience and hard-nosed imagination of a national Steering Group and scores of attendees at a multi-day Workshop. The study has involved scores of professionals and business people from various areas: astronauts; space booster technology and operations professionals; a hotel architect and a hotel operator; an airline planner; insurance underwriters; space sickness experts; space theme park designers; space and travel and tourism association and business executives; a space-related financier; university tourism and space policy experts; present and former space-responsible government officials; space entrepreneurs; space writers; This study concludes that serious national attention should now be given to activities that would enable the expansion of today's terrestrial space tourism businesses, and the creation of in-space travel and tourism businesses. Indeed, it concludes that, in time, it should become a very important part of our Country's overall commercial and civil space business-program structure.
Author
Aerospace Engineering; Low Earth Orbits; NASA Programs; Space Flight; Space Stations; Space Transportation; Travel; Space Habitats

19990032584 NASA Johnson Space Center, Houston, TX USA
STS-88 Mission Highlights Resources Tape, Tape C
Mar. 02, 1999; In English; Videotape: 54 min. 20 sec. playing time, in color, with sound
Report No.(s): JSC-1776/C; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The STS-88 flight crew, Commander Robert D. Cabana, Pilot Frederick W. Sturckow, and Mission Specialists Nancy J. Currie, James H. Newman, Jerry L. Ross, and Sergei Krikalev present a video overview of their space flight. This is the last of three videos which show the highlights of the mission. This video covers the last four days (day 9 - 12) of the mission. Important images

include the closing of the UNITY Connecting Module's hatch, the crew exercising, and the reentry of the spacecraft into Earth's atmosphere.
CASI
Endeavour (Orbiter); Space Flight; Space Transportation System Flights; Manned Space Flight

19990032585 NASA Johnson Space Center, Houston, TX USA
STS-88 Mission Highlights Resources Tape, Tape B
Feb. 26, 1999; In English; Videotape: 1 hour 30 sec. playing time, in color, with sound
Report No.(s): JSC-1776/B; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The STS-88 flight crew, Commander Robert D. Cabana, Pilot Frederick W. Sturckow, and Mission Specialists Nancy J. Currie, James H. Newman, Jerry L. Ross, and Sergei Krikalev present a video overview of their space flight. Tape two of three includes the installation of an S-Band to help monitor the UNITY Connecting Module, the opening of UNITY's hatch, the opening of the main compartment hatch to ZARYA Control Module, and the repair of the inflight maintenance system.
CASI
Endeavour (Orbiter); Space Flight; Space Transportation System Flights; Manned Space Flight; International Space Station

19990032586 NASA Johnson Space Center, Houston, TX USA
STS-88 Mission Highlights Resources Tape, Tape A
Feb. 26, 1999; In English; Videotape: 54 min. 35 sec. playing time, in color, with sound
Report No.(s): JSC-1776/A; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The STS-88 flight crew, Commander Robert D. Cabana, Pilot Frederick W. Sturckow, and Mission Specialists Nancy J. Currie, James H. Newman, Jerry L. Ross, and Sergei Krikalev present a video overview of their space flight. This is the first of three videos which show the highlights of the Endeavour mission. Important visual images include pre-launch activities such as the eating the traditional breakfast, crew suit-up, and the ride out to the launch pad. Also included are various panoramic views of the shuttle on the pad. After the closing of the hatch and arm retraction, launch activities are shown including countdown, engine ignition, launch, and the separation of the Solid Rocket Boosters. Once on-orbit crew members are seen delivering and connecting the UNITY Connecting Module to the ZARYA Control Module.
CASI
Endeavour (Orbiter); Space Flight; Space Shuttle Boosters; Space Transportation System Flights; Manned Space Flight

18
SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.

19990032047 Naval Space Command, Dahlgren, VA USA
Naval Space Command, Space Tracks, A Bulletin on Naval Space Issues and Initiatives, January/February 1999
Feb. 1999; 20p; In English
Report No.(s): AD-A360587; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This issue of "Space Tracks" includes the following articles: (1) "Visual Reality for the Warfighter"; (2) Rear Admiral Zelibor in Command; (3) Navy Ready for GFO Operations; (4) Choice Communications for Warfighters; (5) Iridium Offers Cost-Effective Service; (6) Surveillance Contract Awarded; (7) Tracking John Glenn: 36 Years Later; (8) Young Marines; and (9) Civilians Decorated for Superior Service.
CASI
Navy; Military Operations; Periodicals

19990032576 NASA Johnson Space Center, Houston, TX USA
Delta II Mars Pathfinder
Dec. 04, 1998; In English; Videotape: 1 hour 15 min. playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

Final preparations for lift off of the DELTA II Mars Pathfinder Rocket are shown. Activities include loading the liquid oxygen, completing the construction of the Rover, and placing the Rover into the Lander. After the countdown, important visual events

include the launch of the Delta Rocket, burnout and separation of the three Solid Rocket Boosters, and the main engine cutoff. The cutoff of the main engine marks the beginning of the second stage engine. After the completion of the second stage, the third stage engine ignites and then cuts off. Once the third stage engine cuts off spacecraft separation occurs.
CASI
Mars (Planet); Mars Pathfinder; Mars Missions; Unmanned Spacecraft

19990032577 NASA Johnson Space Center, Houston, TX USA
Mars Climate Orbiter
Dec. 11, 1998; In English; Videotape: 1 hour 2 min. playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The purpose of this mission is to study the climate history and the water distribution of Mars. Beautiful panoramic views of the shuttle on the launch pad, engine ignition, Rocket launch, and the separation and burnout of the Solid Rocket Boosters are shown. The footage also includes an animation of the mission. Detailed views of the path that the Orbiter traversed were shown. Once the Orbiter lands on the surface of Mars, it will dig a six to eight inch hole and collect samples from the planets' surface. The animation also included the prospective return of the Orbiter to Earth over the desert of Utah. The remote sensor on the Orbiter helps in finding the exact location of the Orbiter so that scientists may collect the sample and analyze it.
CASI
Mars (Planet); Mars Surface; Mars Environment; Spacecraft Reentry; Return to Earth Space Flight; Mars Sample Return Missions; Mars Surface Samples; Mars Climate Orbiter

19990032578 NASA Johnson Space Center, Houston, TX USA
Delta II Deep Space I Launch
Oct. 24, 1998; In English; Videotape: 1 hour 33 min. playing time, in color, with sound; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The final preparations of the DELTA II Deep Space I Launch Mission are presented. The footage includes the loading of liquid oxygen, views of the shuttle on the launch pad, countdown, ignition of the engine, launch, burnout and separation of the three Solid Rocket Boosters, separation of the probe from the spacecraft occurring over the Indian Ocean.
CASI
Deep Space 1 Mission; Flyby Missions; NASA Space Programs; Interplanetary Spacecraft

19
SPACECRAFT INSTRUMENTATION

For related information see also 06 Aircraft Instrumentation and 35 Instrumentation and Photography.

19990032089 NASA Glenn Research Center, Cleveland, OH USA
Space Acceleration Measurement System-II: Microgravity Instrumentation for the International Space Station Research Community
Sutliff, Thomas J., NASA Glenn Research Center, USA; March 1999; 10p; In English; 16th; Instrumentation and Measurement Technology, 24-26 May 1999, Venice, Italy; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): RTOP 398-95-0A
Report No.(s): NASA/TM-1999-209047; NAS 1.15:209047; E-11578; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The International Space Station opens for business in the year 2000, and with the opening, science investigations will take advantage of the unique conditions it provides as an on-orbit laboratory for research. With initiation of scientific studies comes a need to understand the environment present during research. The Space Acceleration Measurement System-II provides researchers a consistent means to understand the vibratory conditions present during experimentation on the International Space Station. The Space Acceleration Measurement System-II, or SAMS-II, detects vibrations present while the space station is operating. SAMS-II on-orbit hardware is comprised of two basic building block elements: a centralized control unit and multiple Remote Triaxial Sensors deployed to measure the acceleration environment at the point of scientific research, generally within a research rack. Ground Operations Equipment is deployed to complete the command, control and data telemetry elements of the SAMS-II implementation. Initially, operations consist of user requirements development, measurement sensor deployment and use, and

data recovery on the ground. Future system enhancements will provide additional user functionality and support more simultaneous users.
Author
Acceleration Measurement; Microgravity; International Space Station; Satellite-Borne Instruments; Control Equipment; Command and Control

19990032105 GenCorp Aerojet, Azusa, CA USA
Integrated Advanced Microwave Sounding Unit-A (AMSU-A): Engineering Test Report, METSAT A2 Signal Processor (P/N 1331120-2, S/N F04) S/N 108
October 1998; 25p; In English
Contract(s)/Grant(s): NAS5-32314
Report No.(s): CDRL-207; Rept-11295; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report presents a description of the tests performed, and the test data, for the A2 METSAT Signal Processor Assembly PN: 1331120-2, S/N F04. The assembly was tested in accordance with AE-26754, "METSAT Signal Processor Scan Drive Test and Integration Procedure."
Author
Signal Processing; Signal Analyzers; Instruments

19990032166 GenCorp Aerojet, Azusa, CA USA
Integrated Advanced Microwave Sounding Unit-A (AMSU-A: Engineering Test Report: METSAT A2 Signal Processor (P/N 1331120-2, S/N F03) S/N 107
Oct. 26, 1998; 25p; In English
Contract(s)/Grant(s): NAS5-32314
Report No.(s): NASA/CR-1998-208633; NAS 1.26:208633; Rept-11297; CDRL-207; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report presents a description of the tests performed, and the test data, for the A2 METSAT Signal Processor Assembly PN: 1331120-2, S/N F03. The assembly was tested in accordance with AE-26754, "METSAT Signal Processor Scan Drive Test and Integration Procedure."
Derived from text
Advanced Microwave Sounding Unit; Signal Processing

20
SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also 07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion, and 15 Launch Vehicles and Space Vehicles.

19990028487 NASA Lewis Research Center, Cleveland, OH USA
Rocket-Based Combined Cycle Propulsion System Testing
Perkins, H. Douglas, NASA Lewis Research Center, USA; Thomas, Scott R., NASA Lewis Research Center, USA; DeBonis, James R., NASA Lewis Research Center, USA; Journal of Propulsion and Power; November 1998; Volume 14, No. 6, pp. 1065-1076; In English; 35th; Aerospace Sciences, 6-9 Jan. 1997, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 97-0565; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
ROCKET-based combined cycle (RBCC) engines combine the high thrust-to-weight ratio of rockets with the high specific impulse of ramjets in a single integrated propulsion system that is capable of generating thrust from sea-level-static to high Mach number conditions. The strutjet tested at the NASA Lewis Research Center's (LeRC) Hypersonic Tunnel Facility (HTF) is one example of this engine concept that is being developed cooperatively by a government and industry team. The strutjet is an ejector-ramjet engine in which small, fuel-rich mono-methyl-hydrazine (MMH)/inhibited red fuming nitric acid (IRFNA) rocket chambers are embedded into the trailing edges of the inlet compression struts. The engine operates as an ejector ramjet from takeoff to about Mach 3. At low Mach numbers, entrained air is completely consumed by the fuel-rich rocket exhaust. As freestream Mach number and air-flow increase, JP-10 fuel is introduced to maintain the stoichiometric combustion of all available oxygen. At approximately Mach 3, the strut rockets are turned off. Above Mach 3, the engine operates as a thermally choked ramjet, and then

transitions to supersonic combustion (scramjet) mode. For space-launch applications, the rockets are reignited at a Mach number beyond which air-breathing propulsion becomes impractical. The purpose of this paper is to present the increased operating range achieved by the HTF and the high fidelity of previously completed subscale tests and computational fluid dynamics (CFD) simulations of this engine configuration as demonstrated by the HTF engine data.
Derived from text
Propulsion System Performance; Rocket Engines; Thrust-Weight Ratio; High Impulse; Specific Impulse; Ramjet Engines; Hypersonic Wind Tunnels

19990028561 Alabama Univ., Huntsville, AL USA
Experimental investigation of a rocket based combined cycle (RBCC) engine in a direct-connect test facility
Nelson, K. W., Alabama Univ., USA; Hawk, C. W., Alabama Univ., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 11-23; In English; See also 19990028559
Contract(s)/Grant(s): NGT8-52825; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

With the maturation of key technologies and the need for a more economical space transportation system, there is renewed interest in the Rocket Based Combined Cycle (RBCC) engine. A RBCC is an integration of rocket and airbreathing propulsion into a single system. The RBCC potentially combines the advantages of a rocket's thrust to weight ratio with an airbreather's superior specific impulse. An experimental study to investigate RBCC operation at ramjet and scramjet flight conditions is currently underway. The hardware is being tested in the Direct Connect Supersonic Combustion Test Facility at NASA Langley Research Center. The facility's hydrogen/oxygen/air vitiated heater is capable of simulating flight total enthalpies up to Mach 7.5. The apparatus being tested consists of a gaseous hydrogen/oxygen linear, strut rocket ejector, provided by Aerojet Propulsion Company, and a dual-mode scramjet combustor section. A unique, direct thrust measurement system was also developed for this experiment. Typical freestream Mach number simulations will range from 4 to 6.5 based on total temperature. The effectiveness of the rocket as a fuel injector, pilot, and/or flameholder will be addressed as well as its impact on combined operation performance, namely thrust and Specific Impulse (I(sub sp)). The purpose of this paper is to provide a description of the experiment and present preliminary test results. The preliminary results of an analytical study of the configuration using a one-dimensional thermo-equilibrium code are also presented.
Author
Air Breathing Engines; Ramjet Engines; Space Transportation System; Thrust; Rocket Engines; Reusable Rocket Engines; Spacecraft Propulsion; Turborocket Engines; Experiment Design; Rocket Engine Design

19990028562 Pennsylvania State Univ., Dept. of Mechanical Engineering, University Park, PA USA
Rocket ejector studies for application to RBCC engines: An integrated experimental/CFD approach
Lehman, S. P. M., Pennsylvania State Univ., USA; Broda, J. C., Pennsylvania State Univ., USA; Santoro, R. J., Pennsylvania State Univ., USA; Merkle, C. L., Pennsylvania State Univ., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 25-34; In English; See also 19990028559
Contract(s)/Grant(s): NAS8-40890; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The rocket based combined cycle (RBCC) approach is a promising concept for advanced space transportation systems. The RBCC engine concept integrates air breathing propulsion with rocket propulsion to exploit atmospheric air as the oxidizer during the course of the vehicle trajectory. Although there are quite a few design variations, the gamut of concepts includes four flight regimes, viz. rocket-ejector, ramjet, scramjet and all rocket. of these four flight regimes, the rocket-ejector mode that encompasses the zero to roughly two Mach number range of the flight vehicle, is the least well understood. The goal of the current project is to investigate this mode utilizing a joint experimental/analytical approach. The experimental phase of the program includes studying the mixing and combustion characteristics of the rocket-ejector system utilizing state-of-the-art diagnostic techniques. In this vein, a two-dimensional variable geometry rocket-ejector system with enhanced optical access has been designed and fabricated. The system design is based on an earlier study, however, the goal of this program is to systematically increase the range of understanding over a wide range of flow/geometry parameters. Concurrently with the experimental phase, a computational fluid dynamic analytical approach is also being developed and utilized to investigate the rocket-ejector mode of the RBCC engine. In this paper, the rocket-ejector experiments/analyses are described along with initial results.
Author
Air Breathing Engines; Computational Fluid Dynamics; Ramjet Engines; Space Transportation System; Propulsion; Rocket Engines; Experiment Design; Rocket Engine Design; Ejectors

19990032065 NASA Goddard Space Flight Center, Greenbelt, MD USA

Nanosatellite Propulsion Development Program

Gagosian, J. S., NASA Goddard Space Flight Center, USA; Rhee, M. S., NASA Goddard Space Flight Center, USA; Zakrzwski, C. M., NASA Goddard Space Flight Center, USA; 1999; In English; Micro/NanoTechnology for Space Applications, 11-15 Apr. 1999, Pasadena, CA, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Earth-orbiting nanosatellite constellations are a unique and exciting means toward fulfilling part of the mission of the Goddard Space Flight Center (GSFC). These constellations, which may consist of several hundred 10-kg spacecraft, present unique challenges in the area of propulsion. Many mission concepts require significant delta-v and attitude control capability to reside in the nanosatellites. In response to requirements from mission feasibility studies, such as the Magnetospheric Constellation study, the GSFC has initiated industry and government partnerships to develop enabling propulsion technologies. The largest challenge has been to meet the power constraints of nanosatellites. These power issues, combined with the high thrust required by many of the missions studied, have led the GSFC to concentrate its efforts on chemical propulsion technology. Electric propulsion technologies capable of performing efficiently at very low power are also of interest to the GSFC as potential candidates for nanosatellite formation flying missions. This paper provides the status of specific industrial or government partnerships undertaken by the GSFC to develop nano/micro propulsion components. Three specific technologies are described in detail: 1) Nanosatellite Solid Rocket Motor Prototype 2) Ultra-Low-Power Cold Gas Thruster for Spin-Axis Precession 3) Micro-Machined Solid-Propellant Gas Generators.

Author

Nanosatellites; Mission Planning; NASA Programs; Solid Propellant Rocket Engines; Constellations; Electric Propulsion; Chemical Propulsion; High Thrust

23
CHEMISTRY AND MATERIALS (GENERAL)

19990028502 Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC USA

Economic Impact and Regulatory Flexibility Analyses of the Final Architectural Coatings VOC Rule ***Final Report***

Conner, L., Environmental Protection Agency, USA; Jul. 1998; 234p; In English

Report No.(s): PB99-115560; EPA/452/R-98/002; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report evaluates the impacts of the final rule for controls of volatile organic compounds (VOC) in architectural and industrial maintenance coatings. Total social costs are estimated by evaluating costs of compliance with the rule and associated market impacts, including: price changes for 13 market segments, adjustments in quantity produced, small entity impacts, and employment losses. The report also evaluates the economic incentives to producers associated with an exemption provision and an option to pay a fee for emissions from products that are formulated to exceed the standards.

NTIS

Air Pollution; Pollution Control; Protective Coatings; Economic Impact

19990031834 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Physico-chemical stability of solid surfaces ***Final Report***

Michalske, T. A., Department of Energy, USA; Jennison, D. R., Department of Energy, USA; Feibelman, P. J., Department of Energy, USA; Houston, J. E., Department of Energy, USA; Kellogg, G. L., Department of Energy, USA; Jun. 30, 1998; 12p; In English, USA

Report No.(s): DE98-003520; SAND-98-1106; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The application of physico-chemical phenomena to either increase machinability of hard materials, improve the wear resistance of cutting surfaces, or enhance sintering of particle compacts can have large economic impact on technologies ranging from materials forming processes to oil well drilling. Unfortunately, the broad application of these physico-chemical principles is limited by the authors ability to predict the optimum conditions for a wide variety of materials surfaces. Predictive models must be built upon understanding of the elementary events involved in surface damage and mobility. The authors have developed a new approach to examine the fundamental mechanisms controlling physico-chemical surface stability that combines: (1) atomic-scale control of surface contact forces and displacements under well controlled adsorbate conditions using the Interfacial Force Microscope, (2) atomic-level imaging of surface and near-surface structure and defects using Field Ion Microscopy, and (3) first-principles modeling of the effect of surface stress on adsorbate bonding interactions and the subsequent generation of surface damage. This unique combination of approaches has provided new insights into observed physico-chemical phenomena and provided the

basis for developing true predictive models that are needed for wide application of these important new approaches to modifying the surface sensitive properties of materials.
NTIS
Physical Chemistry; Solid Surfaces; Surface Stability

19990032513 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Destruction of 2,2',3 - trichlorobiphenyl in aqueous solution by Hydrous Pyrolysis/Oxidation (HPO)
Leif, R. N., Department of Energy, USA; Knauss, K. G., Department of Energy, USA; Mew, D. A., Department of Energy, USA; Aines, R. D., Department of Energy, USA; Nov. 25, 1997; 21p; In English
Report No.(s): DE98-058335; UCRL-ID-129837; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Aqueous, low-temperature oxidation rates for the polychlorinated biphenyl (PCB) congener 2,2',3-trichlorobiphenyl have been measured in aqueous phosphate-buffered solutions using Dickson-type reaction vessels. Concentrations of the target compounds were determined by gas chromatography and compound identification was verified by gas chromatography - mass spectrometry. The reaction temperatures ranged from 131 C to 165 C and the activation energy for the destruction of 2,2',3-trichlorobiphenyl was estimated to be 134 kJ/mole. In a low concentration experiment (approximately 500 ng/g starting concentration), 2,2',3-trichlorobiphenyl concentration reached non- detect in two days at 135 C. In a much higher concentration experiment (approximately 24,000 mg/g initial loading), nearly 40% of the initial 2,2',3- trichlorobiphenyl concentration, or about 10,000 ng/g was destroyed at 161 C in 18 days. The 2,2', 3-trichlorobiphenyl concentration of 24,000 ng/g measured at 131 C represents a greater than 100 fold increase in the aqueous solubility compared to the value of 200 ng/g at 20 C reported by Mackay et al. During the experiments the reacted portion of the 2, 2', 3-trichlorobiphenyl was completely mineralized, as indicated by a stoichiometric production of inorganic carbon and chloride ion, and no intermediates amenable to gas chromatography were observed during the HPO experiments. These preliminary experiments indicate that hydrous pyrolysis/oxidation (HPO) may be a useful alternative method for remediating soil and groundwater contaminated with PCBs.
NTIS
Polychlorinated Biphenyls; Oxidation; Pyrolysis; Aqueous Solutions; Contamination; Stoichiometry

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see 27 Nonmetallic Materials.

19990028332 Department of Energy, Washington, DC USA
Application of sensitivity coefficients for heat conduction problems
Dowding, K. J., Department of Energy, USA; Blackwell, B. F., Department of Energy, USA; Cochran, R. J., Department of Energy, USA; Feb. 28, 1998; 13p; In English; Thermophysics and heat transfer, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): DE98-004238; SAND-98-0543C; CONF-980610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In parameter estimation considerable insight is provided by examining sensitivity coefficients. This paper focuses on the use of sensitivity coefficients in connection with estimating thermal properties in the heat conduction equation. A general methodology for computing sensitivity coefficients can be an important design tool. The use of such a tool is demonstrated in this paper. A control volume, finite element program is used, and briefly described, to implement numerical sensitivity coefficient calculations. In this approach general problems can be studied. Several example problems are presented to demonstrate the insight gained from sensitivity coefficients. The problems are selected from experimental studies to characterize the thermal properties of carbon-carbon composite. Sensitivity coefficients show that in an experiment that is not well designed, additional materials in the experimental configuration can have a larger impact on the temperature than the material of interest. Two-dimensional configurations demonstrate that there can be isolated areas of insensitivity and the difficulty of estimating multiple parameters.
NTIS
Sensitivity; Coefficients; Conductive Heat Transfer; Thermal Conductivity

19990028384 Engineering Software Research and Development, Inc., Saint Louis, MO USA

Design and Analysis of Composite Multilayered Shells ***Final Report***

Actis, Ricardo L.; Oct. 27, 1997; 52p; In English

Contract(s)/Grant(s): NSF DMI-93-21005

Report No.(s): AD-A360536; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The principal objective of this investigation was to provide a reliable and efficient prototype software for the engineering design and analysis of multilayered composite shells, capable of modeling linear and nonlinear behavior in three dimensions. In addition, it should be capable of assessing the quality of the solution and providing feedback on the basis of which the solution quality can be improved. Its hierarchic structure should allow the selection of models of increasing complexity in an adaptive way, such that the goals of computation are satisfied within the required accuracy and with minimal effort. The project addressed the investigation of a hierarchic sequence of models for multilayered composite shells and their implementation within the framework of the p-version of the finite element method. In the Phase I project, we investigated the use of the hierarchic models for the analysis of bending of laminated (flat) plates. Phase II utilized the results of Phase I to fully assess the problems associated with bending/membrane coupling and curvature, and extend those results to the nonlinear (small-strain, large-deformation) solution methods for laminated shells, where the most significant technological contributions are to be realized.

DTIC

Computer Programs; Stress Analysis; Composite Structures; Shells (Structural Forms); Finite Element Method; Laminates; Plates (Structural Members)

19990028387 NASA Lewis Research Center, Cleveland, OH USA

Effects of Combustion Conditions on the Strength Melt-Infiltrated SiC/BN/SiC Composites at 800 C

Ogbuji, L. U., Dynacs Engineering Co., Inc., USA; Morscher, G. N., Case Western Reserve Univ., USA; DiCarlo, J. A., NASA Lewis Research Center, USA; 1998; In English; Ceramics, 25-30 Jan. 1998, Cocoa Beach, FL, USA; Sponsored by American Ceramic Society, USA

Contract(s)/Grant(s): RTOP 537-04-22; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The environmental durability of SiC/BN/SiC composites, reinforced with Hi-Nicalon(Trademark) and Sylramic(Trademark) fibers, respectively, were evaluated for comparison - by exposure in the burner rig and in oxygen with various moisture contents, followed by mechanical testing to determine residual strength properties and micrography to ascertain the modes of degradation. The severest damage occurred in burner rig exposure of the Hi-Nicalon material, which proved otherwise resistant to degradation in a slow-flowing but moist oxidant mix. An environment-dependent behavior was found for the Sylramic material: severity of degradation scaled linearly with oxidant moisture content, without a dramatic loss of strength.

Author

Combustion; Silicon Carbides; Residual Strength; Exposure; Burners; Moisture Content

19990028401 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Deep high-aspect ratio Si etching for advanced packaging technologies

Shul, R. J., Department of Energy, USA; Willison, C. G., Department of Energy, USA; Sullivan, C. T., Department of Energy, USA; Kravitz, S. H., Department of Energy, USA; Zhang, L., Department of Energy, USA; May 31, 1998; 12p; In English; 193rd, USA; Sponsored by Electrochemical Society, Inc., USA

Report No.(s): DE98-003344; SAND-98-0608C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Deep high-aspect ratio Si etching (HARSE) has shown potential application for passive self-alignment of dissimilar materials and devices on Si carriers or waferboards. The Si can be etched to specific depths and; lateral dimensions to accurately place or locate discrete components (i.e lasers, photodetectors, and fiber optics) on a Si carrier. It is critical to develop processes which maintain the dimensions of the mask, yield highly anisotropic profiles for deep features, and maintain the anisotropy at the base of the etched feature. In this paper the authors report process conditions for HARSE which yield etch rates exceeding 3 (micro)m/min and well controlled, highly anisotropic etch profiles. Examples for potential application to advanced packaging technologies will also be shown.

NTIS

High Aspect Ratio; Etching; Silicon; Packaging

19990028512 NASA Marshall Space Flight Center, Huntsville, AL USA

NDE Process Development Specification for SRB Composite Nose Cap

Suits, M., NASA Marshall Space Flight Center, USA; February 1999; 12p; In English

Report No.(s): NASA/TM-1999-209148; NAS 1.15:209148; M-915; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Shuttle Upgrade program is a continuing improvement process to enable the Space Shuttle to be an effective space transportation vehicle for the next few decades. The Solid Rocket Booster (SRB), as a component of that system, is currently undergoing such an improvement. Advanced materials, such as composites, have given us a chance to improve performance and to reduce weight. The SRB Composite Nose Cap (CNC) program aims to replace the current aluminum nose cap, which is coated with a Thermal Protection System and poses a possible debris hazard, with a lighter, stronger, CNC. For the next 2 years, this program will evaluate the design, material selection, properties, and verification of the CNC. This particular process specification cites the methods and techniques for verifying the integrity of such a nose cap with nondestructive evaluation.

Author

Nondestructive Tests; Nose Cones; Coatings; Thermal Protection; Space Transportation; Space Shuttles

19990028614 NASA Langley Research Center, Hampton, VA USA

Scaling Effects in Carbon/Epoxy Laminates Under Transverse Quasi-Static Loading

Nettles, Alan T., NASA Langley Research Center, USA; Douglas, Michael J., Old Dominion Univ., USA; Estes, Eric E., Virginia Polytechnic Inst. and State Univ., USA; March 1999; 42p; In English

Contract(s)/Grant(s): RTOP 538-13-11-05

Report No.(s): NASA/TM-1999-209103; NAS 1.15:209103; L-17813; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Scaling effects were considered for 8, 16, 32, and 64 ply IM-7/8551-7 carbon/epoxy composites plates transversely loaded to the first significant load drop by means of both a quasi-static and an equivalent impact force. The resulting damage was examined by x-ray and photomicroscopy analysis. Load-deflection curves were generated for the quasi-static tests and the resulting indentation depth was measured. Results showed that the load-deflection data scaled well for most of the various thicknesses of plates. However, damage did not scale as well. No correlation could be found between dent depth and any of the other parameters measured in this study. The impact test results showed that significantly less damage was formed compared to the quasi- static results for a given maximum transverse load. The criticality of ply-level scaling (grouping plies) was also examined.

Author

Scaling; Epoxy Matrix Composites; Impact Tests; Static Tests; Static Loads

19990028646 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA

New multilength scale plate theory with delamination

Williams, T. O., Department of Energy, USA; Nov. 30, 1997; 10p; In English; 39th; Structures, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): DE98-001457; LA-UR-97-3307; CONF-980419; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Laminated composite plates and shells are potential candidates for many demanding structural applications. A natural choice of analytical/numerical model for the analysis of such structures are equivalent two-dimensional (2D) plate and shell theories. These types of theories provide an efficient and potentially accurate alternative to the use of a three-dimensional finite element (FE) analysis. to effectively model the behavior of composite structures a plate theory must be able to accurately model a variety of inherent history-dependent phenomena. These phenomena include plasticity, viscoplasticity, viscoelasticity, constituent damage within lamina, delamination, and local (sublaminate) and global buckling of the plate. Delamination and local buckling operate at length scales on the order of the lamina thickness. The global buckling and overall motion of a plate can be associated with dimensions of the order of the laminate thickness. A new type of laminated plate theory is presented. It is based on a generalized displacement framework obtained from a superposition of global and local displacement fields. The functional forms of the global and local displacements are arbitrary. The theory represents a novel two length scale or local-global approach to plate analysis. The theory incorporates delamination and/or nonlinear elastic or inelastic interfacial behavior in a unified fashion through the use of interfacial constitutive relations. The theory accounts for nonlinearities in the von Karman sense to allow for the analysis of buckling behavior. Thus, the theory represents a general framework for obtaining any order and type of displacement based plate

theory in the presence of delamination, buckling, and/or nonlinear material behavior as well as the interactions between these effects.
NTIS
Composite Materials; Plate Theory; Delaminating; Laminates; Plates (Structural Members); Composite Structures

19990031837 Department of Energy, Washington, DC USA
Modeling macroscopic response of random composites
Aidun, J. B., Department of Energy, USA; Rintoul, M. D., Department of Energy, USA; Lo, D. C. S., Department of Energy, USA; Feb. 28, 1998; 6p; In English; Engineering Mechanics, USA; Sponsored by American Society of Civil Engineers, USA
Report No.(s): DE98-004099; SAND-98-0430C; CONF-980525; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Preliminary work is presented on an effort to generate synthetic constitutive data for random composite materials. The long-ranged goal is to use the overall response determined from finite element simulations of representative volumes (RV) of the heterogeneous material to construct a homogenized constitutive model. A simple composite of a matrix containing polydispersed spheres was chosen as the first configuration to simulate. Here the accuracy of the numerical simulation tools is tested by determining effective elastic constants of the ordered elastic composite in which equal- sized spheres are arranged in each of three cubic lattice configurations. The resulting anisotropic effective elastic constant values agree with theoretical results to better than 10%, with typical agreement being better than 4%.
NTIS
Composite Materials; Mathematical Models

19990031891 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Near-net-shape fabrication by forced-flow, thermal-gradient CVI
Besmann, T. M., Department of Energy, USA; Stinton, D. P., Department of Energy, USA; Lowden, R. A., Department of Energy, USA; Probst, K. J., Department of Energy, USA; Anderson, T. J., Department of Energy, USA; May 31, 1998; 13p; In English; Innovative materials in advanced energy technologies, USA
Report No.(s): DE98-005579; ORNL/CP-98250; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Forced-flow, thermal gradient chemical vapor infiltration (FCVI) has been developed for the rapid densification of ceramic matrix composites. For preforms of greater than 3 mm thickness FCVI can produce a near-net-shape part in less than one day as opposed to isothermal, isobaric CVI which requires several weeks to density such a component. Efforts at ORNL and elsewhere have resulted in capability to produce prototypical thick-walled heat exchanger tubes and turbine disk blanks. This paper reviews recent modeling and experimental efforts related to the FCVI of cylindrical forms.
NTIS
Chemical Vapor Infiltration; Fabrication; Temperature Gradients

19990032038 NASA Glenn Research Center, Cleveland, OH USA
An Analysis of the Macroscopic Tensile Behavior of a Nonlinear Nylon Reinforced Elastomeric Composite System Using MAC/GMC
Assaad, Mahmoud, Goodyear Tire and Rubber Co., USA; Arnold, Steven M., NASA Glenn Research Center, USA; March 1999; 28p; In English
Contract(s)/Grant(s): RTOP 505-23-2L
Report No.(s): NASA/TM-1999-209066; NAS 1.15:209066; E-11620; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A special class of composite laminates composed of soft rubbery matrices and stiff reinforcements made of steel wires or synthetic fibers is examined, where each constituent behaves in a nonlinear fashion even in the small strain domain. Composite laminates made of piles stacked at alternating small orientation angles with respect to the applied axial strain are primarily dominated by the nonlinear behavior of the reinforcing fibers. However; composites with large ply orientations or those perpendicular to the loading axis, will approximate the behavior of the matrix phase and respond in even a more complex fashion for arbitrarily stacked piles. The geometric nonlinearity due to small cord rotations during loading was deemed here to have a second order effect and consequently dropped from any consideration. The user subroutine USRMAT within the Micromechanics Analysis Code with the Generalized Method of Cells (MAC/GMC), was utilized to introduce the constituent material nonlinear behavior. Stress-strain behavior at the macro level was experimentally generated for single and multi ply composites comprised of continuous Nylon-66 reinforcements embedded in a carbon black loaded rubbery matrix. Comparisons between the predicted macro composite behavior and experimental results are excellent when material nonlinearity is included in the analysis. In this paper, a brief review of

GMC is provided, along with a description of the nonlinear behavior of the constituents and associated constituent constitutive relations, and the improved macro (or composite) behavior predictions are documented and illustrated.
Author
Micromechanics; Elastomers; Stress-Strain Relationships; Laminates; Nonlinear Systems; Reinforcing Fibers; Axial Strain

19990032039 NASA Glenn Research Center, Cleveland, OH USA
Rate Dependent Deformation and Strength Analysis of Polymer Matrix Composites
Goldberg, Robert K., NASA Glenn Research Center, USA; Stouffer, Donald C., Cincinnati Univ., USA; March 1999; 34p; In English
Contract(s)/Grant(s): RTOP 523-24-13
Report No.(s): NASA/TM-1999-209060; NAS 1.15:209060; E-11596; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A research program is being undertaken to develop rate dependent deformation and failure models for the analysis of polymer matrix composite materials. In previous work in this program, strain-rate dependent inelastic constitutive equations used to analyze polymers have been implemented into a mechanics of materials based composite micromechanics method. In the current work, modifications to the micromechanics model have been implemented to improve the calculation of the effective inelastic strain. Additionally, modifications to the polymer constitutive model are discussed in which pressure dependence is incorporated into the equations in order to improve the calculation of constituent and composite shear stresses. The Hashin failure criterion is implemented into the analysis method to allow for the calculation of ply level failure stresses. The deformation response and failure stresses for two representative uniaxial polymer matrix composites, IM7/977-2 and AS4-PEEK, are predicted for varying strain rates and fiber orientations. The predicted results compare favorably to experimentally obtained values.
Author
Polymer Matrix Composites; Deformation; Strain Rate; Failure Analysis; Micromechanics; Pressure Dependence; Shear Stress

19990032092 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Modelling fracture in fibrous microstructures
Beyerlein, I., Department of Energy, USA; Apr. 30, 1998; 7p; In English; Engineering mechanics, USA; Sponsored by American Society of Civil Engineers, USA
Report No.(s): DE98-005283; LA-UR-98-139; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This work describes some complementary studies directed towards micromechanical modeling and simulation of the statistical fracture process in composites with fibrous microstructures. A few studies involve combining efficient computational stress analyses and piezospectroscopic measurement techniques to quantify interface deformation around a single break in model composites. It is shown how estimated interface parameters can be used to predict activity around more complex break arrangement in much larger composites. The final studies involve incorporating these experimentally refined stress analyses into large scale simulation for statistical predictions and subsequent analytical modeling of composite fracture.
NTIS
Mathematical Models; Fracturing; Microstructure; Composite Materials; Fibers

19990032204 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Repair of Damage to Marine Sandwich Structures, Pt. 1, Static Testing
Thomson, Rodney; Luescher, Raoul; Grabovac, Ivan; Oct. 1998; 41p; In English
Report No.(s): AD-A360620; DSTO-TR-0736-PT-1; DODA-AR-010-662-Pt-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Marine vessels constructed from sandwich panels with glass reinforced polymer (GRP) composite skins and PVC foam core are now common. Such structures will inevitably be subjected to damage and any repair technique needs to ensure that the strength and stiffness of the structure are restored. The current recommended Royal Australian Navy (RAN) techniques for the repair of sandwich structures have been evaluated and deficiencies identified. Static tests conducted under four-point bending indicate that the presence of voids in the bondline seriously affect the strength of the repair. Modified repair techniques are proposed to simplify the repair procedure while improving the repair quality and repeatability. The test results show that the modified techniques overcome the problems associated with the RAN repair techniques.
DTIC
Damage; Static Tests; Sandwich Structures; Armed Forces; Maintenance; Navy

19990032210 NASA Langley Research Center, Hampton, VA USA

A {3,2}-Order Bending Theory for Laminated Composite and Sandwich Beams

Cook, Geoffrey M., George Washington Univ., USA; Tessler, Alexander, NASA Langley Research Center, USA; Composites Part B; 1998; ISSN 1359-8368; Volume 29B, pp. 565-576; In English; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A higher-order bending theory is derived for laminated composite and sandwich beams thus extending the recent {1,2}-order theory to include third-order axial effect without introducing additional kinematic variables. The present theory is of order {3,2} and includes both transverse shear and transverse normal deformations. A closed-form solution to the cylindrical bending problem is derived and compared with the corresponding exact elasticity solution. The numerical comparisons are focused on the most challenging material systems and beam aspect ratios which include moderate-to-thick unsymmetric composite and sandwich laminates. Advantages and limitations of the theory are discussed.

Author

Bending Theory; Composite Structures; Laminates; Sandwich Structures; Beams (Supports)

19990032212 NASA Langley Research Center, Hampton, VA USA

Development of Textile Reinforced Composites for Aircraft Structures

Dexter, H. Benson, NASA Langley Research Center, USA; 1998; 10p; In English; 4th; Textile Composites, 12-14 Oct. 1998, Kyoto, Japan; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

NASA has been a leader in development of composite materials for aircraft applications during the past 25 years. In the early 1980's NASA and others conducted research to improve damage tolerance of composite structures through the use of toughened resins but these resins were not cost-effective. The aircraft industry wanted affordable, robust structures that could withstand the rigors of flight service with minimal damage. The cost and damage tolerance barriers of conventional laminated composites led NASA to focus on new concepts in composites which would incorporate the automated manufacturing methods of the textiles industry and which would incorporate through-the-thickness reinforcements. The NASA Advanced Composites Technology (ACT) Program provided the resources to extensively investigate the application of textile processes to next generation aircraft wing and fuselage structures. This paper discusses advanced textile material forms that have been developed, innovative machine concepts and key technology advancements required for future application of textile reinforced composites in commercial transport aircraft. Multiaxial warp knitting, triaxial braiding and through-the-thickness stitching are the three textile processes that have surfaced as the most promising for further development. Textile reinforced composite structural elements that have been developed in the NASA ACT Program are discussed. Included are braided fuselage frames and window-belt reinforcements, woven/stitched lower fuselage side panels, stitched multiaxial warp knit wing skins, and braided wing stiffeners. In addition, low-cost processing concepts such as resin transfer molding (RTM), resin film infusion (RFI), and vacuum-assisted resin transfer molding (VARTM) are discussed. Process modeling concepts to predict resin flow and cure in textile preforms are also discussed.

Author

Composite Materials; Aircraft Structures; Cost Effectiveness; Textiles; Resins; Composite Structures; Laminates

19990032293 NASA Langley Research Center, Hampton, VA USA

Optimal Design of General Stiffened Composite Circular Cylinders for Global Buckling with Strength Constraints

Jaunky, N., Old Dominion Univ., USA; Ambur, D. R., NASA Langley Research Center, USA; Knight, N. F., Jr., Old Dominion Univ., USA; Composite Structures; 1998; ISSN 0263-8223; Volume 41, pp. 243-252; In English

Contract(s)/Grant(s): NAG1-1588; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

A design strategy for optimal design of composite grid-stiffened cylinders subjected to global and local buckling constraints and strength constraints was developed using a discrete optimizer based on a genetic algorithm. An improved smeared stiffener theory was used for the global analysis. Local buckling of skin segments were assessed using a Rayleigh-Ritz method that accounts for material anisotropy. The local buckling of stiffener segments were also assessed. Constraints on the axial membrane strain in the skin and stiffener segments were imposed to include strength criteria in the grid-stiffened cylinder design. Design variables used in this study were the axial and transverse stiffener spacings, stiffener height and thickness, skin laminate stacking sequence and stiffening configuration, where stiffening configuration is a design variable that indicates the combination of axial, transverse and diagonal stiffener in the grid-stiffened cylinder. The design optimization process was adapted to identify the best suited stiffening configurations and stiffener spacings for grid-stiffened composite cylinder with the length and radius of the cylinder, the design in-plane loads and material properties as inputs. The effect of having axial membrane strain constraints in the skin and stiffener segments in the optimization process is also studied for selected stiffening configurations.

Author

Buckling; Circular Cylinders; Design Analysis; Stiffening; Axial Strain

19990032560 NYMA, Inc., Cleveland, OH USA

Design, Fabrication, and Characterization of High Temperature Joints in Ceramic Composites

Singh, M., NYMA, Inc., USA; 1998; 6p; In English; EnCera '98, 6-9 Sep. 1998, Osaka, Osaka, Japan, Japan

Contract(s)/Grant(s): RTOP 274-00-00; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Ceramic joining has been recognized as one of the enabling technologies for the successful utilization of ceramic components in a number of demanding, high temperature applications. Various joint design philosophies and design issues have been discussed along with an affordable, robust ceramic joining technology (ARCJoinT). A wide variety of silicon carbide-based composite materials, in different shapes and sizes, have been joined using this technology. This technique is capable of producing joints with tailorable thickness and composition. The room and high temperature mechanical properties and fractography of ceramic joints have been reported. These joints maintain their mechanical strength up to 1200C in air. This technology is suitable for the joining of large and complex shaped ceramic composite components and with certain modifications, can be applied to repair of ceramic components damaged in service.

Author

Ceramics; Composite Materials; Fabrication; High Temperature; Mechanical Properties; Silicon Carbides; Ceramic Bonding; Flexural Strength; Fracture Strength

19990032562 NASA Lewis Research Center, Cleveland, OH USA

Effect of Composite Fabrication on the Strength of Single Crystal Al2O3 Fibers in Two Fe-Base Alloy Composites

Draper, Susan L., NASA Lewis Research Center, USA; Aiken, Beverly J. M., Case Western Reserve Univ., USA; 1998; 40p; In English

Contract(s)/Grant(s): RTOP 523-21-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Continuous single-crystal Al2O3 fibers have been incorporated into a variety of metal and intermetallic matrices and the results have consistently indicated that the fiber strength had been reduced by 32 to 50% during processing. Two iron-based alloys, FeNiCoCrAl and FeAlVCMn, were chosen as matrices for Al2O3 fiber reinforced metal matrix composites (MMC) with the goal of maintaining Al2O3 fiber strength after composite processing. The feasibility of Al2O3/FeNiCoCrAl and Al2O3/FeAlVCMn composite systems for high temperature applications were assessed in terms of fiber-matrix chemical compatibility, interfacial bond strength, and composite tensile properties. The strength of etched-out fibers was significantly improved by choosing matrices containing less reactive elements. The ultimate tensile strength (UTS) values of the composites could generally be predicted with existing models using the strength of etched-out fibers. However, the UTS of the composites were less than desired due to a low fiber Weibull modulus. Acoustic emission analysis during tensile testing was a useful tool for determining the efficiency of the fibers in the composite and for determining the failure mechanism of the composites.

Author

Aluminum Oxides; Fiber Composites; Iron Alloys; Intermetallics; Metal Matrix Composites; Single Crystals; Acoustic Emission

25
INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also 77 Thermodynamics and Statistical Physics.

19990028448 Imperial Coll. of Science Technology and Medicine, London UK

Quantification of Inert Gas Monolayer Evolution on an Atomically Rough Calcium (111) Surface Using Cellular Automata *Final Report*

Zacate, Matthew O.; Grimes, Robin W.; Lee, Peter D.; Feb. 11, 1999; 14p; In English

Contract(s)/Grant(s): F61775-98-W-E045

Report No.(s): AD-A360574; EOARD-SPC-98-4027; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking Imperial College, London as follows: The contractor will investigate the use of Cellular Automata (CA) algorithms to advance our understanding of how various transport phenomena such as surface diffusion and adsorption/desorption contribute towards the growth of surface structures.

DTIC

Automata Theory; Calcium; Surface Diffusion; Rare Gases; Gas Evolution; Transport Properties

19990028452 University Coll., National Microelectronic Research Centre, Cork, Ireland

1998 Irish Atomistic Simulators Meeting

Jan. 1999; 9p; In English; Presented at 3rd Irish Atomistic Simulation Conference, 21-22 Dec 98, University Coll. Cork, Ireland.
Contract(s)/Grant(s): F61775-99-W-F006
Report No.(s): AD-A360558; EOARD-CSP-99-5006; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Abstracts Only; Abstracts Only

The Final Proceedings for 1998 Irish Atomistic Simulators Meeting, 16 December 1998 - 17 December 1998. This is an interdisciplinary conference Topics include computation of material properties including polymer and bio-polymer simulation, electronic spectra, and polarizations of solids.

DTIC

Conferences; Electronic Spectra; Simulators; Molecular Dynamics

19990028465 Department of Energy, Office of Energy Research, Washington, DC USA

Studies of hydrogen-hydrogen and carbon-sulfur bond cleavage; Lewis acid modified molybdenum sulfide complexes; and Syntheses and reactions of pyrrole complexes ***Final Report***

Jan. 31, 1998; 35p; In English
Report No.(s): DE98-004192; DOE/ER/13451-T2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The reactions of hydrogen with dinuclear cyclopentadienyl molybdenum complexes containing bridging sulfide ligands have been identified, and detailed kinetic and mechanistic studies have been carried out on selected systems. The work has led to a detailed proposal for the mechanism of heterolytic hydrogen activation by these homogeneous dinuclear complexes. The hydrogen activation reactions have been further applied in reactions with heterocycles and other small molecules, and pathways for the cleavage of carbon- nitrogen, carbon-sulfur, and carbon-oxygen bonds have been determined. The studies have established well characterized pathways for these transformations which involve reactions at the sulfide ligands of the complexes. These systems provide potential models for important hydrotreating reactions which occur on heterogeneous metal sulfide catalysts. In a related project fundamental factors which might promote the activation of nitrogen heterocycles in the hydrotreating process have been explored. New transition metal complexes containing pyrrole and indole have been synthesized, and the coordination modes of the cyclic ligands and their resulting reactivity have been characterized. Complexes which activate the rings toward both nucleophilic addition and nucleophilic substitution reactions have been identified, and further reductions of the cyclic ligands have also been observed.

NTIS

Hydrogen Bonds; Carbon; Sulfur; Cleavage; Molybdenum; Synthesis (Chemistry); Chemical Reactions; Pyrroles; Molybdenum Sulfides

19990028476 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Low damage, highly anisotropic dry etching of SiC

Wang, J. J., Department of Energy, USA; Hong, J., Department of Energy, USA; Lambers, E. S., Department of Energy, USA; Pearton, S. J., Department of Energy, USA; Ren, F., Department of Energy, USA; Mar. 31, 1998; 7p; In English; 4th; High temperature electronics, USA
Report No.(s): DE98-004235; SAND-98-0662C; CONF-980622; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A parametric study of the etching characteristics of 6H p(+) and n(+) SiC and thin film SiC(0.5)N(0.5) in Inductively Coupled Plasma NF3/O2 and NF3/Ar discharges has been performed. The etch rates in both chemistries increase monotonically with NF3 percentage and rf chuck power. The etch rates go through a maximum with increasing ICP source power, which is explained by a trade-off between the increasing ion flux and the decreasing ion energy. The anisotropy of the etched features is also a function of ion flux, ion energy and atomic fluorine neutral concentration. Indium-tin-oxide (ITO) masks display relatively good etch selectivity over SiC (maximum of approximately 70:1), while photoresist etches more rapidly than SiC. The surface roughness of SiC is essentially independent of plasma composition for NF3/O2 discharges, while extensive surface degradation occurs for SiCN under high NF3):O2 conditions.

NTIS

Damage; Anisotropy; Drying; Etching; Silicon Carbides

19990028510 NASA Langley Research Center, Hampton, VA USA

Self-Broadening and Self-Shift Coefficients in the Fundamental Band of 12C 16O

Devi, Malathy V., College of William and Mary, USA; Benner, D. Chris, College of William and Mary, USA; Smith, Mary Ann H., NASA Langley Research Center, USA; Rinsland, Curtis P., NASA Langley Research Center, USA; Journal Quant. Spectroscopy and Radiative Transfer; 1998; ISSN 0022-4073; Volume 60, No. 5, pp. 815-824; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

High quality and precise measurements of self-broadened and self-shift coefficients in the fundamental band of C-12O-16 were made using spectra recorded at room temperature with the high-resolution (0.0027 cm(exp -1)) McMath-Pierce Fourier transform spectrometer located at the National Solar Observatory on Kitt Peak, Arizona. The spectral region under investigation (2008-2247 cm(exp -1)) contains the P(31) to R(31) transitions. The data were obtained using a high-purity natural isotopic sample ofcarbon monoxide and two absorption cells with pathlengths of 4.08 and 9.98 cm, respectively. Various pressures of CO were used, ranging between 0.25 and 201.2 Torr. The results were obtained by analyzing five spectra simultaneously, using a multispectrum nonlinear least-squares fitting technique. The self-broadened coefficients ranged from 0.0426(2) cm(exp -1) atm(exp -1) at 296 K to 0.0924(2) cm(exp -1) atm(exp -1) at 296 K, while the pressure-induced shift coefficients varied between -0.0042(3) cm(exp -1) atm(exp -1) at 296 K and +0.0005(l) cm(exp -1) atm(exp -1) at 296 K. The value in parentheses is the estimated uncertainty in units of the last digit. The self-broadened coefficients of lines with same values of m in the P and R branches agree close to within experimental uncertainties while the self-shift coefficients showed considerable variation within and between the two branches. The mean value of the ratios of P branch to R branch self-broadened coefficients was found to be 1.01 with a standard deviation of + or - 0.01. Comparisons of the results with other published data were made.

Author

Isotopes; Nonlinearity; Carbon Monoxide; Pressure Oscillations; Least Squares Method

19990028521 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Planar laser-induced fluorescence imaging of flame heat release rate

Paul, P. H., Department of Energy, USA; Najm, H. N., Department of Energy, USA; Dec. 12, 1997; 21p; In English; 27th; Combustion, USA

Report No.(s): DE98-052540; SAND-98-8474C; CONF-980804; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Local heat release rate represents one of the most interesting experimental observables in the study of unsteady reacting flows. The direct measure of burning or heat release rate as a field variable is not possible. Numerous experimental investigations have relied on inferring this type of information as well as flame front topology from indirect measures which are presumed to be correlated. A recent study has brought into question many of the commonly used flame front marker and burning rate diagnostics. This same study found that the concentration of formyl radical offers the best possibility for measuring flame burning rate. However, primarily due to low concentrations, the fluorescence signal level from formyl is too weak to employ this diagnostic for single-pulse measurements of turbulent reacting flows. In this paper the authors describe and demonstrate a new fluorescence-based reaction front imaging diagnostic suitable for single-shot applications. The measurement is based on taking the pixel-by-pixel product of OH and CH(sub 2)O planar laser-induced fluorescence images to yield an image closely related to a reaction rate. The spectroscopic and collisional processes affecting the measured signals are discussed and the foundation of the diagnostic, as based on laminar and unsteady flame calculations, is presented. The authors report the results of applying this diagnostic to the study of a laminar premixed flame subject to an interaction with an isolated line-vortex pair.

NTIS

Heat Transfer; Flames; Laser Induced Fluorescence; Research; Unsteady Flow; Imaging Techniques; Premixed Flames

19990028566 Combustion Research and Flow Technology, Inc., Dublin, PA USA

Progress in the computational simulation of turbulence and multiphase combustive processes for airbreathing missiles

Dash, S. M., Combustion Research and Flow Technology, Inc., USA; Sinha, N., Combustion Research and Flow Technology, Inc., USA; Tonello, N. A., Combustion Research and Flow Technology, Inc., USA; Hosangadi, A., Combustion Research and Flow Technology, Inc., USA; Perrell, E. R., Combustion Research and Flow Technology, Inc., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 73-87; In English; See also 19990028559; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

This paper discusses progress made in developing an advanced computational framework for simulating airbreathing missile propulsive flowfields. Ducted rocket, pulse detonation, and, dual mode ram/scram burner engines are implementing energetic propellants and varied mixing enhancement concepts whose simulation requires advances in turbulence and multiphase combustion modeling. This paper assesses nonlinear (explicit algebraic Reynolds-stress) extensions to a k-epsilon framework along with

compressibility and variable Prandtl number models, including comparisons with data and large eddy simulation (LES) hot jet simulations. Varied multiphase combustive advances are summarized for both particle and droplet combustion with a new PDF framework discussed, that predicts the variation in size distribution eliminating size-binning requirements. Computational advances discussed include parallel architecture domain decomposition structured and unstructured frameworks with dynamic noncontiguous grid interfacing.
Author
Combustion; Large Eddy Simulation; Missile Design; Parallel Processing (Computers); Computational Fluid Dynamics; Propellant Combustion; Computerized Simulation; K-Epsilon Turbulence Model

19990028615 NASA Langley Research Center, Hampton, VA USA
Spectroscopic Parameter for Ozone and its Isotopes: Current Status, Prospects for Improvement, and the Identification of O-16 O-16 O-17 and O-16 O-17 O-16 Lines in Infrared Ground-Based and Stratospheric Solar Absorption Spectra
Rinsland, C. P., NASA Langley Research Center, USA; Flaud, J.-M., Centre National de la Recherche Scientifique, France; Goldman, A., Denver Univ., USA; Perrin, A., Centre National de la Recherche Scientifique, France; Camy-Peyret, C., Centre National de la Recherche Scientifique, France; Smith, M. A. H., NASA Langley Research Center, USA; Devi, V. Malathy, College of William and Mary, USA; Benner, D. C., College of William and Mary, USA; Barbe, A., Reims Univ., France; Stephens, T. M., Denver Univ., USA; Murcray, F. J., Denver Univ., USA; Journal of Quantative Spectroscopy and Radiative Transfer; 1998; ISSN 0022-4073; Volume 60, No. 5, pp. 803-814; In English
Contract(s)/Grant(s): NCC1-80; NCC1-43; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
We describe the updates to the spectroscopic parameters of ozone and its isotopes in the 1996 High Altitude Atmospheric Transmission (HITRAN)compilation. Recent published studies not included in HITRAN are also summarized. Finally, we report the identification of infrared lines of the v(sub 3) bands of O-16 O-16 O-17 and O-16 O-17 O-16 in high-resolution solar spectra recorded by stratospheric balloon-borne and ground-based Fourier transform spectrometers.
Author
Oxygen Isotopes; Ozone; Stratosphere; Absorption Spectra; Remote Sensing

19990028793 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Zirconium-titanium phosphate acid catalysts synthesized by sol gel techniques
Jackson, N. B., Department of Energy, USA; Thoma, S. G., Department of Energy, USA; Kohler, S., Department of Energy, USA; Nenoff, T. M., Department of Energy, USA; Mar. 31, 1998; 9p; In English; 7th; Scientific bases for the preparation of heterogeneous catalysts, USA
Report No.(s): DE98-005781; SAND-98-0716C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Recently a large effort has been put into identifying solid acid materials, particularly sulfated zirconia and other sulfated metal oxides, that can be used to replace environmentally hazardous liquid acids in industrial processes. The authors are studying a group of mixed metal phosphates, some of which have also been sulfated, for their catalytic and morphological characteristics. Zirconium and titanium are the metals used in this study and the catalysts are synthesized from alkoxide starting materials with H3PO4, H2O, and sometimes H2SO4 as gelling agents. The measurement of acidity was achieved by using the isomerization of 2-methyl-2-pentane as a model reaction. The phosphate stabilized the mixed metal sulfates, preventing them from calcining to oxides boosting their initial catalytic activity. The addition of sulfate prevented the formation of the catalytically inactive mixed metal pyrophosphates when calcined at high temperatures (> 773 K).
NTIS
Catalytic Activity; Sol-Gel Processes; Zirconium; Titanium; Phosphates; Synthesis (Chemistry)

19990031847 Department of Energy, Office of Energy Research, Washington, DC USA
High Resolution Photoelectron Images and D(sup +) Photofragment Images Following 532-nm Photolysis of D(sub 2)
Chandler, D. W., Department of Energy, USA; Neyer, D. W., Department of Energy, USA; Heck, A. J., Department of Energy, USA; Jan. 31, 1998; 11p; In English; BIOS '98: Biomedical Optics, 1998, USA
Report No.(s): DE98-052544; SAND-98-8493C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The non-resonant ionization and dissociation of D(sub 2) by intense 532-nm laser light is studied by a variation of the 'Ion Imaging' technique called 'Velocity Mapping'. Images of both the photoelectrons and D(sup +) photofragments are obtained and analyzed at two different laser intensities. Results are compared to previous studies and several differences are discussed.
NTIS
Deuterium; Imaging Techniques

19990031850 Department of Energy, Washington, DC USA

Thermal Decomposition Behavior of Ammonium Perchlorate and of an Ammonium-Perchlorate-Based Composite Propellant

Behrens, R., Department of Energy, USA; Minier, L., Department of Energy, USA; Mar. 24, 1998; 22p; In English; Hazards Subcommitte Joint Meeting, 1996, USA; Sponsored by Department of the Army, USA

Report No.(s): DE98-052556; SAND-97-8422C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The thermal decomposition of ammonium perchlorate (AP) and ammonium-perchlorate-based composite propellants is studied using the simultaneous thermogravimetric modulated beam mass spectrometry (STMBMS) technique. The main objective of the present work is to evaluate whether the STMBMS can provide new data on these materials that will have sufficient detail on the reaction mechanisms and associated reaction kinetics to permit creation of a detailed model of the thermal decomposition process. Such a model is a necessary ingredient to engineering models of ignition and slow-cookoff for these AP-based composite propellants. Results show that the decomposition of pure AP is controlled by two processes. One occurs at lower temperatures (240 to 270 C), produces mainly H2O, O2, Cl2, N2O and HCl, and is shown to occur in the solid phase within the AP particles. 200(micro) diameter AP particles undergo 25% decomposition in the solid phase, whereas 20(micro) diameter AP particles undergo only 13% decomposition. The second process is dissociative sublimation of AP to NH3 + HClO4 followed by the decomposition of, and reaction between, these two products in the gas phase. The dissociative sublimation process occurs over the entire temperature range of AP decomposition, but only becomes dominant at temperatures above those for the solid-phase decomposition. AP-based composite propellants are used extensively in both small tactical rocket motors and large strategic rocket systems. NTIS

Thermal Decomposition; Ammonium Perchlorates; Composite Propellants

19990031883 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Theoretical energy release of thermites, intermetallics, and combustible metals

Fischer, S. H., Department of Energy, USA; Grubelich, M. C., Department of Energy, USA; Jun. 30, 1998; 59p; In English; 24th; Pyrotechnics, USA

Report No.(s): DE98-005512; SAND-98-1176C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Thermite (metal oxide) mixtures, intermetallic reactants, and metal fuels have long been used in pyrotechnic applications. Advantages of these systems typically include high energy density, impact insensitivity, high combustion temperature, and a wide range of gas production. They generally exhibit high temperature stability, and possess insensitive ignition properties. In this paper, the authors review the applications, benefits, and characteristics of thermite mixtures, intermetallic reactants, and metal fuels. Calculated values for reactant density, heat of reaction (per unit mass and per unit volume), and reaction temperature (without and with consideration of phase changes and the variation of specific heat values) are tabulated. These data are ranked according to density, heat of reaction, reaction temperature, and gas production. NTIS

Thermites; Intermetallics; Metal Fuels; Metal Combustion

19990031889 Department of Energy, Washington, DC USA

VCSEL applications in sensors and microsystems

Warren, M. E., Department of Energy, USA; Carson, R. F., Department of Energy, USA; Sweatt, W. C., Department of Energy, USA; Wendt, J. R., Department of Energy, USA; Nevers, J. A., Department of Energy, USA; Jan. 31, 1998; 12p; In English; BIOS 1998: Biomedical optics, 1998, USA

Report No.(s): DE98-005539; SAND-98-1235C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Vertical-cavity surface-emitting lasers (VCSELs) are uniquely suited to miniaturized free-space optical systems in which surface-mounting and hybrid assembly techniques can be used to combine different technologies together. Two examples are described of such microsystems that are being developed for sensing applications. The first example is a optical position sensing system for rotating parts. Progress on fabricating similar systems by flip-chip bonding techniques is then discussed. The second example is a chemical sensing/analysis system which uses a miniature fluorescence detection module that is based on surface-mounted VCSELs and diffractive optical elements. The detection module is integrated with a capillary electrochromatography separation system and uses substrate-mode light propagation to focus the VCSEL beam on the capillary channel. NTIS

Surface Emitting Lasers; Laser Cavities; Aerospace Systems

19990032132 Department of Energy, Office of Energy Research, Washington, DC USA

Theory and computational modeling: Medium reorganization and donor/acceptor coupling in electron transfer processes

Newton, M. D., Department of Energy, USA; Feldberg, S. W., Department of Energy, USA; Smalley, J. F., Department of Energy, USA; Mar. 31, 1998; 59p; In English

Report No.(s): DE98-004404; BNL-65271; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The continuing goal is to convert the rapidly accumulating mechanistic information about electron transfer (ET) kinetics (often representable in terms of simple rate constants) into precise tools for fine-tuned control of the kinetics and for design of molecular-based systems which meet specified ET characteristics. This treatment is limited to the kinetic framework defined by the assumption of transition state theory (TST). The primary objective of this paper is to report recent advances in the theoretical formulation, calculation, and analysis of energetics and electronic coupling pertinent to ET in complex molecular aggregates. The control of ET kinetics (i.e., enhancing desired processes, while inhibiting others) involves, of course, both system energetics, especially reorganization energies E(sub r) and free energy changes Delta G(sup 0) and electronic coupling of local D and A sites, which for thermal processes is most directly relevant only after the system has reached the appropriate point (or region) along the reaction coordinate (i.e., the transition state). The authors first discuss TST rate constant models, emphasizing genetic features, but also noting some special features arising when metal electrodes are involved. They then turn to a consideration of detailed aspects of medium reorganization and donor/acceptor coupling. With these theoretical tools in hand, they examine the results of recent applications to complex molecular systems using the techniques of computational quantum chemistry and electrostatics, together with detailed analysis of the numerical results and comparison with recent electrochemical kinetic data.

NTIS

Binding Energy; Mathematical Models; Electron Transfer; Reaction Kinetics; Acceptor Materials; Computational Chemistry; Kinetic Theory

19990032140 Department of Energy, Washington, DC USA

Hydrous pyrolysis of pole treating chemicals: (a) initital measurement of hydrous pyrolysis rates for napthalene and pentachlorophenol; (b) solubility of flourene at temperatures up to 150 C

Leif, R., Department of Energy, USA; Nov. 15, 1997; 31p; In English

Report No.(s): DE98-058863; UCRL-CR-129838; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The temperature dependencies of the hydrous pyrolysis/oxidation (HPO) aqueous phase oxidation reactions of naphthalene and pentachlorophenol have been determined for phosphate buffered systems using Dickson-type reaction vessels. The HPO experimental temperatures ranged from 114 C to 148 C for naphthalene and 114 C to 137 C for pentachlorophenol. The loss of the organic species was used to determine activation energies of 95.8 kJ/mole for naphthalene oxidation and 84.8 kJ/mole for pentachlorophenol oxidation. Aqueous concentrations of target compounds and reaction intermediates were determined by gas chromatography and compound identification was verified by gas chromatography - mass spectrometry. During the experiments the pollutants were completely mineralized, as indicated by a stoichiometric production of inorganic carbon in the case of naphthalene and inorganic carbon and chloride in the case of pentachlorophenol. HPO of pentachlorophenol produced 2,3,5,6- tetrachlorophenol as an intermediate, whereas no intermediates amenable by GC were observed during the HPO of naphthalene. Measurements of the aqueous solubility of florin in an unbuffered solution have been made covering the temperature range from 20 C to 150 C. There is very good agreement between this data set and data previously published covering the lower temperature range (20 C to 75 C). Extension of the solubility measurements to higher temperatures covers the in situ temperatures achievable during field application of HPO and demonstrated a nearly exponential rise in aqueous solubility as a function of temperature, with a 10 fold increase in aqueous florin solubility going from 75 C to 125 C and a 20 fold increase in going from 75 C to 150 C.

NTIS

Pyrolysis; Oxidation; Temperature Dependence; Naphthalene; Phenols; Solubility; Phosphates

19990032158 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Numerical and experimental investigation of vortical flow-flame interaction

Najm, H. N., Department of Energy, USA; Schefer, R. W., Department of Energy, USA; Milne, R. B., Department of Energy, USA; Mueller, C. J., Department of Energy, USA; Devine, K. D., Department of Energy, USA; Feb. 28, 1998; 152p; In English

Report No.(s): DE98-052586; SAND-98-8232; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A massively parallel coupled Eulerian-Lagrangian low Mach number reacting flow code is developed and used to study the structure and dynamics of a forced planar buoyant jet flame in two dimensions. The numerical construction uses a finite difference scheme with adaptive mesh refinement for solving the scalar conservation equations, and the vortex method for the momentum equations, with the necessary coupling terms. The numerical model construction is presented, along with computational issues regarding the parallel implementation. An experimental acoustically forced planar jet burner apparatus is also developed and used

to study the velocity and scalar fields in this flow, and to provide useful data for validation of the computed jet. Burner design and laser diagnostic details are discussed, along with the measured laboratory jet flame dynamics. The computed reacting jet flow is also presented, with focus on both large-scale outer buoyant structures and the lifted flame stabilization dynamics. A triple flame structure is observed at the flame base in the computed flow, as is theoretically expected, but was not observable with present diagnostic techniques in the laboratory flame. Computed and experimental results are compared, along with implications for model improvements.
NTIS
Flames; Numerical Analysis; Experimentation; Data Acquisition; Computer Programs; Mach Number; Mathematical Models

19990032234 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Measurement of point defect energetics in potassium dihydrogen phosphate (KDP) ***Final Report***
Cooke, D. W., Department of Energy, USA; Muenchausen, R. E., Department of Energy, USA; Bennett, B. L., Department of Energy, USA; Oct. 31, 1997; 28p; In English
Report No.(s): DE98-004313; LA-UR-97-4967; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Potassium dihydrogen phosphate (KDP) in the normal and deuterated form (KD*P) exhibits excellent electrooptical and nonlinear optical properties and is commonly used in frequency conversion applications. Frequency doubling (2 (omega)) of Nd:YAG or Nd:YLF laser fundamental output at 1.06 microns produces visible radiation at 532 nm with relatively good conversion efficiency. Frequency tripling (3(omega)) and quadrupling (4(omega)) are also utilized for production of ultraviolet (uv) radiation at 355 and 266 nm, respectively. However in the latter case the conversion efficiency is relatively low, especially at high incident fluences (approximately 2 GW/sq cm). A fundamental problem associated with high peak-power laser excitation of KDP is the production of transient optical absorption that inhibits conversion efficiency. The role of point defects on frequency conversion efficiency and optoelectronic device performance in KDP and its isomorphs is not fully understood. However, it is evident from the extant data that their existence, even in pure specimens, affects the overall performance of these technologically important materials, and that further research is required to elucidate their role. Accordingly, they have investigated the temperature- dependent optical absorption and radioluminescence (RL) of pure KDP as well as doped specimens: KDP:Fe, KDP:Cr, and KDP:Al.
NTIS
Potassium Phosphates; Point Defects; Chemical Analysis; Defects; Deuterium Compounds; Electromagnetic Absorption; Optoelectronic Devices

19990032257 Department of Energy, Washington, DC USA
Thin film porous membranes based on sol-gel chemistry for catalytic sensors
Hughes, R. C., Department of Energy, USA; Patel, S. V., Department of Energy, USA; Jenkins, M. W., Department of Energy, USA; Boyle, T. J., Department of Energy, USA; Gardner, T. J., Department of Energy, USA; May 31, 1998; 5p; In English; 7th; Chemical sensors, USA
Report No.(s): DE98-005009; SAND-97-3124C; CONF-980727; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Nanoporous sol-gel based films are finding a wide variety of uses including gas separations and supports for heterogeneous catalysts. The films can be formed by spin or dip coating, followed by relatively low temperature annealing. The authors used several types of these films as coatings on the Pd alloy thin film sensors they had previously fabricated and studied. The sol-gel films have little effect on the sensing response to H2 alone. However, in the presence of other gases, the nanoporous film modifies the sensor behavior in several beneficial ways. (1) They have shown that the sol-gel coated sensors were only slightly poisoned by high concentrations of H2S while uncoated sensors showed moderate to severe poisoning effects. (2) For a given partial pressure of H2, the signal from the sensor is modified by the presence of O2 and other oxidizing gases.
NTIS
Thin Films; Porosity; Membranes; Sol-Gel Processes; Metal Films; Catalysts

19990032429 Northwestern Univ., Evanston, IL USA
Preparation and Characterization of Superhard Materials of Crystalline Carbon Nitride ***Final Report, 15 May 1995 - 14 Nov. 1998***
Chung, Yip-Wah; Feb. 1999; 8p; In English
Contract(s)/Grant(s): F49620-95-1-0384; AF Proj. 2306
Report No.(s): AD-A360508; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Prompted by the prediction of Cohen and coworkers that beta carbon nitride may have properties similar to diamond, there have been many attempts to synthesize this hypothetical metastable material. We successfully synthesized this material via epitax-

ial stabilization using TiN(111) and ZrN(111) as the growth template. The coatings were CN/TiN or CN/ZrN multilayers grown in a dual-magnetron system. The existence of beta carbon nitride in these multilayers has been confirmed with cross-section electron diffraction, Rutherford backscattering, Raman spectroscopy and near-edge x-ray diffraction. Most important, these multilayers exhibit hardness in the 50 GPa, in spite of the large volume fraction (60-70%) of the softer TiN or ZrN component. Attempts to improve the hardness by using TiB2 (which is harder than TiN and ZrN) as the growth template did not work as well because TiB2 was markedly softened by the presence of nitrogen.
DTIC
Carbon; Nitrides; Procedures; Epitaxy; Crystallinity; Synthesis (Chemistry)

19990032432 Defence Science and Technology Organisation, Aeronautical Maritime Research Lab., Fishermens Bend, Australia
Simulation and Modelling of Reacting Particles Relevant to Gas Turbine Engine Combustion
Smith, Nigel S.; Dec. 1998; 39p; In English
Report No.(s): AD-A360602; DSTO-RR-0142; DODA-AR-010-688; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A conditional moment closure model is proposed for reacting particles in turbulent nonpremixed combustion. The new model for particles differs significantly from the traditional uniform diffusivity gas-phase conditional moment closure model. The new features of the model and model effectiveness are examined against direct numerical simulation data for soot-like and droplet-like particles in turbulent nonpremixed combustion. The influence of differing particle sizes, types, and reactivity on the effectiveness of the model closure is examined in detail.
DTIC
Combustion; Mathematical Models; Particle Interactions; Gas Turbines; Direct Numerical Simulation

19990032527 Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA
Advancing the Technology Base for High Temperature Hydrogen Membranes
Dye, R. C., Department of Energy, USA; Moss, T. S., Department of Energy, USA; Oct. 31, 1997; 10p; In English; 5th; Membrane Technology Separations Planning, USA
Report No.(s): DE98-003017; LA-UR-97-3968; CONF-9710158; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

High purity hydrogen is a critical component for at least two major industrial processes: 1) the refining of conventional steels and raw pig iron into low carbon steels and high purity iron used for high performance magnets in motors, generators, alternators, transformers, and etc.; and 2) refining metallurgical grade silicon to the high-purity, polycrystalline silicon used in fabricating single crystal silicon wafers for semiconductor manufacturing. In the process of producing low carbon iron products, CO and CO2 impurities prevent efficient removal of the carbon already in the raw iron. In the refining of metallurgical grade silicon, the presence of any impurity above the part-per-million level prevents the ultimate fabrication of the large scale single crystals that are essential to the semiconductor device. In a lesser magnitude role, high quality hydrogen is used in a variety of other processes, including specialty metals refining (e.g., iridium, osmium, palladium, platinum, and ruthenium) and R&D in areas such as organic synthesis and development of certain types of fuel cells. In all of these applications, a high-temperature hydrogen membrane can provide a method for achieving a very high purity level of hydrogen in a manner that is more economical and/or more rugged than existing techniques.
NTIS
Purification; Refining; Hydrogen; Fabrication; Single Crystals; Metallurgy

19990032535 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Microtechnology for instrumentation
Mariella, R., Department of Energy, USA; Jan. 01, 1998; 11p; In English; Bios 1998: Biomedical optics, 1998, USA
Report No.(s): DE98-052082; UCRL-JC-129215; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

For the last two decades, the majority of research and development at LLNL in microtechnology has focused on photonics devices and bulk micromachining, including microelectro-mechanical systems and associated areas. For the last ten years, we have used these capabilities to address our analytical instrumentation needs. Just as the miniature photonics have enable the fabrication of analytical instruments that are either higher performance, smaller, more portable, or are combinations of these. Examples of these are our portable thermal cyclers for DNA analysis, our hand-held gas chromatograph, our

flow-stream-waveguide-based flow cytometer, and our etched-microchannel electrophoresis systems. This presentation will describe these and related developments.
NTIS
Technologies; Instruments

19990032556 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Hydrogen flame suppression by CF3I
Mcllory, A., Department of Energy, USA; Brady, B., Department of Energy, USA; Marshall, P., Department of Energy, USA; Mar. 31, 1998; 28p; In English; 27th; Combustion, USA
Report No.(s): DE98-052519; SAND-98-8451C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Halons have long been the fire suppressants of choice for applications requiring high performance. However, halons are linked to the stratospheric ozone depletion problem. One promising replacement is CF3I. This compound has been shown to have fire suppression performance similar to that achieved for halon 1301, but with a very low ODP. Unlike halon 1301, CF3I rapidly photolyzes in the troposphere, and thus has a tropospheric lifetime of less than two days. In this study, they seek to build a model for the suppression of hydrogen fires by CF3I. From a fundamental viewpoint, the hydrogen combustion mechanism is appealing because it is the simplest and best characterized of all combustion mechanisms, and an important sub-mechanism of all hydrocarbon combustion mechanisms. One-dimensional, laminar flame calculations are used to determine the major fire suppression mechanisms of CF3I. The remainder of the paper is organized as follows: first, the model is described in detail; second, the experimental method and results are presented and finally, the authors compare the model and experimental results and discuss the major reaction pathways and suppression mechanisms of CF3I in hydrogen flames.
NTIS
Hydrogen; Flames; Hydrogen Fuels; Atmospheric Composition; Retarding; Fluorine Organic Compounds

19990032558 NASA Lewis Research Center, Cleveland, OH USA
Synthesis and Structural Characterization of Tris(dimethyldithiocarbamate)Indium(III), In[S2CN(CH3)2]3
Clark, Eric B., NASA Lewis Research Center, USA; Breen, Marc L., NASA Lewis Research Center, USA; Fanwick, Phillip E., Purdue Univ., USA; Hepp, Aloysius F., NASA Lewis Research Center, USA; Duraj, Stan A., Cleveland State Univ., USA; Journal of Coordination Chemistry; 1998; 12p; In English
Contract(s)/Grant(s): NCC3-281; NCC3-328; NCC3-162; NCC3-246; NCC3-457; RTOP 632-1A-1A; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The synthesis and structure of the indium dithiocarbamate, In[SCN(CH3)2]3*1/2 4-mepy (4-mepy = 4-methylpyridine), is described. Indium metal was oxidized by tetramethylthiuramdisulfide in 4-methylpyridine at 25C to form a new, homoleptic indium(HI) dithiocarbamate in yields exceeding 60%. In[S2CN(CH3)213 exists as a discrete molecule with a distorted-octahedral geometry. The compound crystallizes in the P 1-bar (No. 2) space group with a = 9.282(l)A, b = 10.081(1)A, c = 12.502 A, alpha= 73.91 (1) degrees, beta = 70.21(1) degrees, gamma = 85.84(1) degrees, Z = 2,v(A(exp 3)) =1057.3(3), R = 0.046, and R(sub w) = 0.061.
Author
Indium; Methyl Compounds; Thiols; Carbamides; Crystal Structure; Indium Compounds; Organic Sulfur Compounds; Chemical Reactions

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METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

19990028324 Virginia Univ., Dept. of Physics, Charlottesville, VA USA
Synthesis and Fundamental Studies of Bulk Metallic Systems Based on Unusual Microstructures ***Final Report, 1 Sep. 1994 - 30 Apr. 1998***
Poon, S. J.; Shiflet, G. J.; May 15, 1998; 5p; In English
Contract(s)/Grant(s): DAAH04-94-G-0076
Report No.(s): AD-A358301; ARO-32352.1-MS; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have performed integrative studies of thermal and mechanical effects on the synthesis and properties of bulk titanium-based alloys with nanoscale morphological structures. Alloys are examined by calorimetry, mechanical-property testing, and x-ray and electron diffraction including high-resolution analytical microscopy. New titanium alloys with unusual structural and

physical properties are found and preliminary studies of various phase formation pathways have begun, several key results are reported: (1) A series of high-order beta-phase Ti-alloys obtained as ingots are found to undergo nanocrystallization and amorphization upon annealing. The premise for solid-state vitrification and nanocrystallization (SSVN) is studied in light of the free energy difference between the BETA phase and amorphous phase. (2) The study of SSVN is generalized to include SSV via the mechanical pathway. The easy amorphization via mechanical milling is found to correlate strongly with SSVN via annealing, which provides the basis for future study of ”inverse melting” in our Ti-alloys. (3) Nanoscale spatial resolution of spinodal decomposition in high-order beta Ti-alloys during isothermal annealing is studied using high resolution analytical electron microscopy. (4) The study of SSVN has also resulted in a new class of high-strength beta alloys with good ductility obtained in 85 at.% Ti-alloys with uniformly dispersed nanocrystalline alpha-phase particles.
DTIC
Metals; Mechanical Properties; Microstructure; Titanium Alloys; Thermodynamic Properties; Amorphous Materials; High Strength Alloys; Alpha Particles

19990028351 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Characterization of welding residual stresses with neutron diffraction
Wang, X. L., Department of Energy, USA; Spooner, S., Department of Energy, USA; Hubbard, C. R., Department of Energy, USA; Taljat, B., Department of Energy, USA; Feng, Z., Department of Energy, USA; Mar. 31, 1998; 6p; In English; Experimental and Applied Mechanics, 1998, USA
Report No.(s): DE98-004895; ORNL/CP-97550; CONF-980627; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Welding residual stresses are a key concern in the fabrication and use of structural components containing welds. Residual stresses in welds are caused by non-uniform expansion and shrinkage of differently heated zones during the thermal transient of a weld pass. In some alloys, solid state phase transformations occurring during the welding transient contribute additional residual stresses. Manufacturing problems arising from welding residual stresses include cracking and dimensional distortion. During use, tensile stresses in the welded zone limit the fatigue resistance of the component under cyclic loading. In an aggressive environment, tensile welding residual stresses also create a necessary condition for stress-corrosion cracking to take place.
NTIS
Welded Joints; Neutron Diffraction; Tensile Stress; Phase Transformations; Fatigue (Materials); Residual Stress

19990028354 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Fatigue cracking of coextruded 304L/CS tubes
Swindeman, R. W., Department of Energy, USA; Keiser, J. R., Department of Energy, USA; Maziasz, P. J., Department of Energy, USA; Singbeil, D. L., Department of Energy, USA; Mar. 31, 1998; 7p; In English; 9th; Corrosion in the Pulp and Paper Industry, USA
Report No.(s): DE98-004887; ORNL/CP-97557; CONF-980555; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The mechanical and thermal fatigue of authentic stainless steels was examined for the maximum temperature range expected in coextruded floor tubes of recovery boilers to determine the likelihood that the cracking in the 304L stainless steel cladding could be fatigue related. The microstructures and cracking patterns of fatigue-tested specimens were compared to features observed in cracked cladding and significant differences were found which suggested that fatigue was not the most likely cause for failure. Biaxial thermal fatigue testing of coextruded tubes and panels was performed to gather more evidence of cracking patterns. Here, transient thermal stresses were imposed by rapidly heating the tubing surface with lamps. In spite of high surface temperatures, no cracks were produced in the 304L stainless steel cladding, and this observation was interpreted as evidence that cracking must be corrosion related.
NTIS
Crack Propagation; Stainless Steels; Fatigue Tests; Pipes (Tubes); Thermal Fatigue

19990028364 Naval Postgraduate School, Dept. of Mechanical Engineering, Monterey, CA USA
Microstructural Characterization of Ti-44Al-11Nb in the Chill-Cast and Directionally Solidified Configurations
Halladay, Timothy R.; Dec. 1998; 85p; In English
Report No.(s): AD-A359595; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The microstructural evolution in chill-cast and directionally solidified Ti-44Al-11Nb (at.%) was studied by x-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) methods. From this data, the microstructural distribution and formation sequences of various phases like Al3Ti, TiAl, and Ti3Al were established. The elemental

and phase distributions were determined by TEM with energy dispersive x-ray spectroscopy (EDX) and spectrum imaging. Both casting techniques produced the same phases, (Al3Ti, TiAl, and Ti3Al with some Nb in solid solution), but the microstructural distribution was markedly different. The chill-casting technique resulted in a coarser microstructure, with large gamma crystals and duplex regions of either (gamma + alpha2) or (gamma + Al3Ti) interspersed throughout the alloy. The directional solidification technique resulted in a much more uniform microstructure with fine lamellar grains in a dendritic macrostructure. Both casting techniques showed enrichment of niobium in interdendritic regions.
DTIC
Titanium Alloys; Castings; Aluminum Alloys; Microstructure; Directional Solidification (Crystals); Niobium Alloys

19990028376 Department of Energy, Office of Energy Research, Washington, DC USA
Interface diffusion in polysynthetically-twinned TiAl
Luzzi, D. E., Department of Energy, USA; Imamura, D., Department of Energy, USA; Inui, H., Department of Energy, USA; Yamaguchi, M., Department of Energy, USA; George, E. P., Department of Energy, USA; Dec. 31, 1997; 8p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-004898; ORNL/CP-97537; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The utility of polysynthetically-twinned (PST) TiAl, which contains a high density of parallel, atomically-flat interfaces within a set of identical crystallographic orientations, as a potential model system for a detailed investigation of interface diffusion is explored. Macroscopic PST crystals were grown in an optical float zone furnace. Thin films were cut from oriented crystals and polished with alpha less than amp 112 alpha amp greater than directions normal to the film. After sputter cleaning, Ag was deposited on one side of the TiAl thin films. Auger spectra were obtained from these films over a wide range of sputter/anneal conditions. The Al and Ti concentrations were analyzed as well as the important impurity elements, S, Ar, C, N and O. Using the present data and existing knowledge of the microstructure and crystallography of PSI TiAl, the potential of this material for providing a detailed understanding of the atomistic mechanisms of interface diffusion is analyzed.
NTIS
Interfaces; Diffusion; Titanium Alloys; Aluminum Alloys; Impurities; Crystal Structure

19990028382 Department of Energy, Washington, DC USA
Free form fabrication of metallic components using the Directed Light Fabrication process
Lewis, G. K., Department of Energy, USA; Milewski, J. O., Department of Energy, USA; Nemec, R. B., Department of Energy, USA; Thoma, D. J., Department of Energy, USA; Mar. 31, 1998; 9p; In English; 15th; Thermal spray, USA
Report No.(s): DE98-004363; LA-UR-97-5106; CONF-980533; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Directed Light Fabrication (DLF) process uses a laser beam and metal powder, fed into the laser focal zone, to produce free standing metal components that are fully dense and have structural properties equivalent to conventional metal forming processes. The motion of the laser focal zone is precisely controlled by a motion path produced from a 3 dimensional solid model of a desired component. The motion path commands move the focal zone of the laser such that all solid areas of the part are deposited and the part can be built (deposited) in its entirety to near net shape, typically within +/- 0.13 mm. The process is applicable to any metal or intermetallic. Full density and mechanical properties equivalent to conventionally processed material are achieved.
NTIS
Fabrication; Intermetallics; Forming Techniques

19990028396 Department of Energy, Washington, DC USA
Effects of 800 MeV proton irradiation on the corrosion of tungsten, tantalum, stainless steel, and gold
Lillard, R. S., Department of Energy, USA; Butt, D. P., Department of Energy, USA; Kanner, G., Department of Energy, USA; Daemen, L., Department of Energy, USA; Dec. 01, 1997; 41p; In English, USA
Report No.(s): DE98-004316; LA-UR-97-5011; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Real time electrochemical data were acquired for tungsten, tantalum, stainless steel 304L, and gold targets during proton irradiation at the LANSCE Weapons Neutron Research Facility. The goal of this research was to establish a better understanding of the corrosion properties of materials as a function of proton irradiation and gain insight into the mechanism of the observed phenomena. The following electrochemical observations were made during proton irradiation of W, Ta, SS304, and Au: (1) the open circuit potential of all materials increased with increasing proton fluence; (2) the corrosion rate (at the OCP) of W and SS304 increased with increasing proton fluence; (3) the passive dissolution rate for SS304 and Ta decreased with increasing proton flu-

ence; (4) the anodic dissolution rate for W increased with increasing proton fluence; (5) the pitting potential for SS304 increased with proton fluence, which is an indication that the material is less susceptible to pitting attack during irradiation.
NTIS
Proton Irradiation; Corrosion; Tungsten; Tantalum; Stainless Steels; Gold

19990028404 Department of Energy, Washington, DC USA
Model for the shock-induced phase transition in iron
Boettger, J. C., Department of Energy, USA; Wallace, D. C., Department of Energy, USA; Oct. 31, 1997; 15p; In English; Shock Compression of Condensed Matter, USA; Sponsored by American Physical Society, USA
Report No.(s): DE98-000823; LA-UR-97-2706; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

It has long been known that the shock induced alpha to epsilon phase transition in iron exhibits significant metastability in the two phase region above 13 GPa. The authors have developed a simple, physically motivated model that accurately describes the metastable phase transition surface for shock loaded iron during numerical simulations. It is demonstrated here that the metastability of Fe can have a substantial impact on numerical simulations of time-resolved experiments.
NTIS
Iron; Phase Transformations; Mathematical Models; Computerized Simulation

19990028520 Department of Energy, Office of Energy Research, Washington, DC USA
Investigation of medium to high strain deformation microstructures using an automated electron back scatter pattern (EBSP) system
Godfrey, A., Department of Energy, USA; Hughes, D. A., Department of Energy, USA; Krieger Lassen, N. C., Department of Energy, USA; Jensen, D. J., Department of Energy, USA; Mar. 31, 1998; 4p; In English; Microscopy and Microanalysis 1998, 1998, USA
Report No.(s): DE98-052596; SAND-98-8533C; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The speed of automated EBSP orientation gathering has now increased to a point where it is possible to examine large areas of deformed material at a resolution close to the length scale of the dislocation substructures involved (typically alpha amp; amp less than 1 micron for strains of greater than (epsilon) = 1). Investigation of such deformed samples invariably gives rise to diffraction images of low quality and to many double patterns. to assist in a critical selection of the data, it is usual to store a measure of the indexing confidence for each point. Here the authors describe how deformed samples, which provide the appropriate range of pattern qualities, can be used to calibrate acceptance criteria for unsupervised EBSP measurements on deformation microstructures. An application in the use of such criteria is also described. Two crystals chosen with orientations that are known to develop a well defined texture spread during deformation were channel die deformed to a strain of (epsilon) = 1.5 (78% reduction). The texture spread was determined for each sample from a large number of transmission electron microscope (TEM) orientation measurements taken using a fast semi-automatic technique. EBSP scans were then made on the samples. Orientations failing within the expected (TEM determined) texture spread are assumed to be correct. While those falling outside the expected spread are assumed to be incorrect. Unsupervised acceptance criteria based on an indexing confidence parameter (in their case the fraction of located Kikuchi bands matching the indexing solution) were then tested by comparing the set of orientations selected using a given approval criterion with the set of the orientations falling within the expected spread. Criteria were appraised by determining both the fraction of all orientations that were misclassified (incorrect orientations selected plus correct orientations not selected) or by the fraction of incorrect orientations in the selected data set.
NTIS
Research; Strain Measurement; Aluminum; Diffraction; Crystals; Acceptability

19990028632 Department of Energy, Office of Energy Research, Washington, DC USA
Room temperature tensile properties of Fe-Al single crystals strengthened by excess vacancies
Yoshimi, K., Department of Energy, USA; Saeki, Y., Department of Energy, USA; Hanada, S., Department of Energy, USA; Yoo, M. H., Department of Energy, USA; Feb. 28, 1998; 28p; In English; Sponsored by Minerals, Metals and Materials Society, USA
Report No.(s): DE98-005047; ORNL/CP-96784; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Effects of supersaturated excess vacancies on plastic deformation of Fe-Al were investigated by tensile testing at room temperature three different single crystals (Fe-33, 41 and 44 mol.% Al). Critical resolved shear stresses (CRSSs) of slowly-cooled specimens (as-homogenized specimens) and well-annealed specimens (vacancy-eliminated specimens) were almost the same and did not show A1 concentration dependence. On the other hand, the CRSS of vacancy-containing specimens (fast-cooled specimens) was significantly higher than that of the others, even for Fe-33 mol.%A1, and showed strong A1 concentration dependence.

The fast-cooled specimens displayed serrated flow behavior during work- hardening at room temperature, and the serrated flow was more intensive at a higher A1 composition. Deformation microstructures of Fe-44 mol.% Al were examined by TEM, and it was found that dislocations in fast-cooled specimen were inhomogeneously distributed suggesting jerky motion of slip dislocations. These dislocations were oriented along an unstable direction estimated from dislocation line tension. In addition, there were numerous dislocation loops. A dislocation mechanism of the excess vacancy strengthening is discussed on the basis of the experimental results.
NTIS
Tensile Properties; Room Temperature; Single Crystals; Aluminum Alloys; Iron Alloys

19990028763 Naval Research Lab., Washington, DC USA
Corrosion-Fatigue Crack Initiation in 7000-Series Al Alloys
Pao, Peter S., Naval Research Lab., USA; Feng, C. R. Jerry, Naval Research Lab., USA; Gill, Steven J., Naval Research Lab., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 831-840; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The mechanisms of corrosion-fatigue crack initiation by pitting in high-strength 7000-series aluminum alloys were studied. The alloys used in this investigation were 7075-T7351 and 7050-T7451. Corrosion pits were formed in a 3.5% NaCl solution by the electrochemical reaction between the constituent particles and the surrounding matrix. Depending on whether these particles were cathodic (C-type) or anodic (A-type) relative to the alloy matrix, the pits formed as a consequence of matrix (around cathodic particles) or particle (for anodic particles) dissolution. In the 7075 alloy, both C-type and A-type particles were present. In the 7050 alloy, only C-type particles were present. The C-type particles were identified, using transmission electron microscopic techniques, as Al23CuFe4 in the 7075 alloy and Al7Cu2Fe in the 7050 alloy. Because these particles tend to cluster parallel to the rolling plane in the rolling direction, significant pit growth from pit coalescence was observed following prolonged exposure to a salt water environment. The effect of pre-existing corrosion pits on fatigue crack initiation was investigated using blunt-notch fracture mechanics specimens oriented in the short-transverse direction to obtain cracks in the same orientation as those that grow from rivet holes. Results to date indicate that the presence of corrosion pits can significantly shorten the fatigue crack initiation life and decrease the threshold stress intensity of the alloy by as much as 50 percent. Post initiation analyses further confirmed that, when corrosion pits were present, fatigue cracks always initiated from these pits. In the absence of pits, fatigue cracks initiated from large inclusions. The identification of the constituent particles, the mechanism of pit formation and growth, and the analyses of fatigue crack initiation kinetics are discussed.
Author
Aluminum Alloys; Corrosion; Fatigue (Materials); Crack Initiation; High Strength Alloys

19990028764 NASA Langley Research Center, Hampton, VA USA
Determination of the Corrosive Conditions Present within Aircraft Lap-Splice Joints
Lewis, Karen S., Virginia Univ., USA; Kelly, Robert G., Virginia Univ., USA; Piascik, Robert S., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 841-852; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The complexity of airframe structure lends itself to damage resulting from crevice corrosion. Fuselage lap-splice joints are a particularly important structural detail in this regard because of the difficulty associated with detection and measurement of corrosion in these occluded regions. The objective of this work is to develop a laboratory corrosion test protocol to identify the chemistry to which lap joints are exposed and to develop a model of the corrosion within the joints. A protocol for collecting and identifying the chemistry of airframe crevice corrosion has been developed. Capillary electrophoresis (CE) is used to identify the ionic species contained in corrosion product samples removed from fuselage lap splice joints. CE analysis has been performed on over sixty corrosion product samples removed from both civilian and military aircraft. Over twenty different ions have been detected. Measurements of pH of wetted corroded surfaces indicated an alkaline occluded solution. After determining the species present and their relative concentrations, the resultant solution was reproduced in bulk and electrochemical tests were performed to determine the corrosion rate. Electrochemical analyses of the behavior of AA2024-T3 in these solutions gave corrosion rates of up to 250 microns per year (10 mpy). Additional tests have determined the relative importance of each of the detected ions in model solutions used for future predictive tests. The statistically significant ions have been used to create a second generation solution. Laboratory studies have also included exposure tests involving artificial lap joints exposed to various simulated bulk and crevice environments. The extent and morphology of the attack in artificial lap joints has been compared to studies of corroded

samples from actual aircraft. Other effects, such as temperature and potential, as well as the impact of the environment on fatigue crack growth have also been studied.
Author
Lap Joints; Fuselages; Corrosion Tests; Cavitation Corrosion; Electrophoresis; Structural Analysis

19990028767 Honeywell Technology Center, Minneapolis, MN USA
Acoustic Detection of In Situ Corrosion in Aging Aircraft
Schoess, Jeffrey N., Honeywell Technology Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 872-874; In English; See also 19990028721; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Hidden and inaccessible corrosion in aircraft structures is the number-one logistics problem for the U.S. Air Force, with an estimated maintenance cost in excess of $1.0 billion per year in 1990-equivalent dollars. Reliable detection of hidden corrosion damage using conventional nondestructive inspection (NDI) techniques is a difficult task, requiring significant maintenance training and manpower to access damaged structural locations. This paper summarizes a novel in situ measurement approach using stress-wave acoustic emission (AE) technology to detect and quantify corrosion damage without removing structural panels. A summary problem statement, existing NDI methods, and their limitations, corrosion factors, design concept approach for using AE, and design implementation details are presented.
Author
Structural Analysis; Aircraft Structures; In Situ Measurement; Acoustic Emission; Corrosion; Fault Detection; Nondestructive Tests

19990028789 Department of Energy, Washington, DC USA
Potts model simulation of grain size distributions during final stage sintering
Zeng, P., Department of Energy, USA; Tikare, V., Department of Energy, USA; Dec. 31, 1998; 9p; In English, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005906; SAND-97-3052C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Potts Monte Carlo model was used to simulate microstructural evolution and characterize grain size distribution during the final stages of sintering. Simultaneous grain growth, pore migration and pore shrinkage were simulated in a system with an initial porosity of 10% with varying ratios of grain boundary mobility to pore shrinkage rates. This investigation shows that the presence of pores changes the grain size distribution and the topological characteristics due to pinning of grains by pores. As pores shrink away, their pinning effect decreases. Once pore shrinkage is complete, normal grain growth is achieved.
NTIS
Simulation; Grain Size; Sintering; Size Distribution

19990028822 Naval Postgraduate School, Monterey, CA USA
An Electron Backscatter Diffraction Analysis of the Microstructure of Pure Aluminum Processed by Equal-Channel Angular Pressing
Terhune, Shannon D.; Dec. 1998; 55p; In English
Report No.(s): AD-A359663; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Equal-channel angular (ECA) pressing is a promising method to achieve refinement of grain size to 1.0 micrometer or less for aluminum and its alloys. Computer-aided electron backscatter diffraction (EBSD) analysis of high purity aluminum (99.99%) which had been subjected to one pass, four passes, and twelve passes through an ECA die was performed. Grain and subgrain size and boundary misorientation distributions during such large-strain deformation processing were of particular interest. A texture was present after one pressing and the boundary misorientation distribution had a peak at 5 deg - 10 deg although boundaries were present in all misorientation ranges. Fine equaixed grains were achieved after twelve passes through the ECA die, accompanied by random orientation and misorientation distributions.
DTIC
Aluminum; Electron Diffraction; Microstructure; Pressing (Forming); Grain Size

19990028843 Department of Defense, Washington, DC USA
Modeling anisotropic plasticity: Eulerian hydrocode applications of high strain-rate deformation processes
Clancy, S. P., Department of Defense, USA; Burkett, M. W., Department of Defense, USA; Maudlin, P. J., Department of Defense, USA; Feb. 28, 1998; 12p; In English; Pressure Vessel and Piping (PVP, 1998, USA; Sponsored by Department of Energy, USA
Report No.(s): DE98-005066; LA-UR-97-4784; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Previously developed constitutive models and solution algorithms for anisotropic elastoplastic material strength are implemented in the two dimensional MESA hydrodynamics code. Quadratic yield functions fitted from polycrystal simulations for a metallic hexagonal-close-packed structure are utilized. An associative flow strength formulation incorporating these yield functions is solved using a geometric normal return method. A stretching rod problem is selected to investigate the effects of material anisotropy on a tensile plastic instability (necking). The rod necking rate and topology are compared for MESA simulations performed for both isotropic and anisotropic cases utilizing the elastic-perfectly-plastic and the Mechanical Threshold Stress flow stress models.
NTIS
Mathematical Models; Anisotropy; Plastic Properties; Hydrodynamics; Stress Analysis

19990031841 Department of Energy, Office of Energy Research, Washington, DC USA
Segregation gettering by implantation-formed cavities and B-Si precipitates in silicon
Myers, S. M., Department of Energy, USA; Petersen, G. A., Department of Energy, USA; Follstaedt, D. M., Department of Energy, USA; Jan. 31, 1998; 14p; In English; 8th; Silicon Materials Science and Technology, USA
Report No.(s): DE98-004109; SAND-97-1936C; CONF-980528; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors show that Fe, Co, Cu, and Au in Si undergo strong segregation gettering to cavities and B-Si precipitates formed by He or B ion implantation and annealing. The respective mechanisms are argued to be chemisorption on the cavity walls and occupation of solution sites within the disordered, B-rich, B- Si phase. The strengths of the reactions are evaluated, enabling prediction of gettering performance.
NTIS
Ion Implantation; Cavities; Getters; Silicon; Precipitates; Boron; Separation

19990031844 Department of Energy, Office of Energy Research, Washington, DC USA
Atomistic Study of the Effects of Stress and Hydrogen on a Dislocation Lock in Nickel
Hoagland, R. G., Department of Energy, USA; Baskes, M. I., Department of Energy, USA; Mar. 19, 1998; 9p; In English; Sponsored by Minerals, Metals and Materials Society, USA
Report No.(s): DE98-052523; SAND-98-8500C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Even though austenitic alloys are commonly used in a hydrogen environment, hydrogen-induced fracture of these alloys has been reported. Most recently it has been shown that the failure of these alloys in hydrogen is initiated by void formation at slip band intersections. It is the object of this work to investigate the atomistic mechanisms that occur at these slip band intersections in the presence of hydrogen. Specifically it has been suggested that dislocation-dislocation interactions may play a large role in the initiation of voids or cracks. Hirth has summarized the various forms of dislocation interactions, traditionally called Lomer-Cottrell Locks (LCLs), that can occur. Baskes have investigated the effects of stress on a LCL using an Embedded Atom Method (EAM) model for nickel developed previously by Angelo. The EAM is a well-established semi-empirical method of atomistic calculation that has been successfully used for over a decade to calculate the energetics and structure of defects in transition metals. The work by Angelo established that the trapping of hydrogen to single dislocations had a maximum energy of ca. 0.1 eV while the trapping to a LCL was significantly greater, approximately 0.33 eV, thus the authors expect that a LCL could be important in explaining the fracture behavior of a fcc material in a hydrogen environment. Baskes found that under uniaxial stress a LCL in the absence of hydrogen underwent a number of transitions, but it did not dissociate or form a crack nucleus. In this work the authors extend the previous work to include the effects of hydrogen. Specifically they will simulate the experiments of Moody for the case of room temperature exposure of Inconel to 190 atm of hydrogen.
NTIS
Embedded Atom Method; Hydrogen Embrittlement

19990031848 Department of Energy, Office of Energy Research, Washington, DC USA
Solidification Behavior and Structure of Al-Cu Alloy Welds
Brooks, J. A., Department of Energy, USA; Li, M., Department of Energy, USA; Yang, N. C. Y., Department of Energy, USA; Sep. 30, 1997; 22p; In English; Numerical Analysis of Weldability, 1997, USA
Report No.(s): DE98-052545; SAND-98-8470C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The microsegregation behavior of electron beam (EB) and gas tungsten arc (GTA) welds of Al-Cu alloys covering a range from 0.19 to 7.74 wt% Cu were characterized for dendrite core concentrations and fraction eutectic solidification. Although a single weld speed of 12.7 mm/sec was used, some differences were observed in the segregation behavior of the two weld types. The microsegregation behavior was also modeled using a finite differences technique considering dendrite tip and eutectic under-

cooling and solid state diffusion. Fairly good agreement was observed between measured and calculated segregation behavior, although, differences between the two weld types could not be completely accounted for. The concept of dendrite tip undercooling was used to explain the formation of a single through thickness centerline grain in the higher alloy content GTA welds.
NTIS
Welded Joints; Aluminum Alloys; Copper Alloys; Solidification

19990031867 Oregon Dept. of Transportation, Research Unit, Salem, OR USA
Field Application of a Thermal-Sprayed Titanium Anode for Cathodic Protection of Reinforcing Steel in Concrete ***Final Report***
McGill, G. E., Oregon Dept. of Transportation, USA; Cramer, S. D., Department of Energy, USA; Covino, B. S., Department of Energy, USA; Bullard, S. J., Department of Energy, USA; Holcomb, G. R., Department of Energy, USA; Jan. 1999; 162p; In English; Original contains color illustrations
Report No.(s): PB99-128670; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This study provided the first field trial of a catalyzed, thermal-sprayed titanium anode for cathodic protection of steel reinforced concrete structures. Catalyzed titanium as an anode material offers the advantage of long life due to the inherent non-corrosive nature of the metal in atmospheric exposure. To continue to serve as an anode, the titanium will require a periodic and easily accomplished re-application of the catalyst rather than re-application of the metal. The purpose of this study was to evaluate the installation and operation of the catalyzed titanium anode and to evlauate the economics of the titanium anode system compared to thermal-sprayed zinc. The initial phase of the study included modification of the spray equipment for spraying titanium wire and determination of the optimal spray parameters for applying the titanium anode to the bridge. Coating resistivity was found to be the best measure for evaluating the effectiveness of the coating. Decreasing spray distance, increasing current, and using nitrogen as the atomizing gas (propellant) all decrease coating resistivity. A multiple regression equation developed from the collected data showed that, for the data collected in this study, spray gun travel speed atomizing gas pressure have an insignificant effect on coating resisivity.
NTIS
Reinforcing Materials; Cathodic Coatings; Concrete Structures; Steel Structures; Spraying; Catalysts

19990032057 Department of Energy, Washington, DC USA
Investment Casting Design of Experiment ***Final Report***
Owens, R., Department of Energy, USA; Oct. 31, 1997; 76p; In English
Report No.(s): DE98-051246; KCP-613-6003; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Specific steps in the investment casting process were analyzed in a designed experiment. The casting's sensitivity to changes in these process steps was experimentally determined. Dimensional and radiographic inspection were used to judge the sensitivity of the casting. Thirty-six castings of different pedigrees were poured and measured. Some of the dimensional inspection was conducted during the processing. It was confirmed that wax fixturing, number of gates, gate location, pour and mold temperature, pour speed, and cooling profile all affected the radiographic quality of the casting. Gate and runner assembly techniques, number of gates, and mold temperature affect the dimensional quality of the casting.
NTIS
Investment Casting; Experiment Design

19990032112 Department of Energy, Office of Enegy Research, Washington, DC USA
Solid state bonding of beryllium-copper for an ITER first wall application
Odegard, B. C., Department of Energy, USA; Cadden, C. H., Department of Energy, USA; Feb. 28, 1998; 15p; In English; 3rd; Beryllium Technology for Fusion, USA; Sponsored by International Energy Agency, France
Report No.(s): DE98-052602; SAND-97-8637; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Several different joint assemblies were evaluated in support of a manufacturing technology for diffusion bonding a beryllium armor tile to a copper alloy heat sink for fusion reactor applications. Because beryllium reacts with all but a few elements to form intermetallic compounds, this study considered several different surface treatments as a means of both inhibiting these reactions and promoting a good diffusion bond between the two substrates. A diffusion bonded assemblies used aluminum or an aluminum-beryllium composite (AlBeMet-150) as the interfacial material in contact with beryllium. In most cases, explosive bonding was utilized as a technique for joining the copper alloy heat sink to an aluminum or AlBeMet-150 substrate, which was subsequently diffusion bonded to an aluminum coated beryllium tile. In this approach, a 250 (micro)m thick titanium foil was used as a diffusion barrier between the copper and aluminum to prevent the formation of Cu-Al intermetallic phases. In all cases, a hot isostatic pressing (HIP) furnace was used in conjunction with canned assemblies in order to minimize oxidation and apply sufficient pressure

on the assembly for excellent metal-to-metal contact and subsequent bonding. Several different processing schedules were evaluated during the course of this study; bonded assemblies were produced that failed outside the bond area indicating a 100% joint efficiency.
NTIS
Beryllium; Copper Alloys; Solid State; Thermonuclear Reactions; Surface Treatment; Diffusion Welding; Evaluation

19990032122 Department of Energy, Washington, DC USA
Advances in the reduction and compensation of film stress in high- reflectance multilayer coatings for extreme ultraviolet lithography applications
Mirkarimi, P. B., Department of Energy, USA; Feb. 20, 1998; 19p; In English; 7th; INTERMAG, Unknown
Report No.(s): DE98-058762; UCRL-JC-128293; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Due to the stringent surface figure requirements for the multilayer-coated optics in an extreme ultraviolet (EUV) projection lithography system, it is desirable to minimize deformation due to the multilayer film stress. However, the stress must be reduced or compensated without reducing EUV reflectivity, since the reflectivity has a strong impact on the throughput of a EUV lithography tool. In this work we identify and evaluate several leading techniques for stress reduction and compensation as applied to Mo/Si and Mo/Be multilayer films. The measured film stress for Mo/Si films with EUV reflectances near 67.4% at 13.4 nm is approximately - 420 MPa (compressive), while it is approximately +330 MPa (tensile) for Mo/Be films with EUV reflectances near 69.4% at 11.4 nm. Varying the Mo-to-Si ratio can be used to reduce the stress to near zero levels, but at a large loss in EUV reflectance. The technique of varying the base pressure (impurity level) yielded a 10% decrease in stress with a 2% decrease in reflectance for our multilayers. Post-deposition annealing was performed and it was observed that while the cost in reflectance is relatively high (3.5%) to bring the stress to near zero levels (i.e., reduce by 1 00%), the stress can be reduced by 75% with only a 1.3% drop in reflectivity at annealing temperatures near 200(degrees)C. A study of annealing during Mo/Si deposition was also performed; however, no practical advantage was observed by heating during deposition. A new non-thermal (athermal) buffer-layer technique was developed to compensate for the effects of stress. Using this technique with amorphous silicon and Mo/Be buffer-layers it was possible to obtain Mo/Be and Mo/Si multilayer films with a near zero net film stress and less than a 1% loss in reflectivity. For example a Mo/Be film with 68.7% reflectivity at 11.4 nm and a Mo/Si film with 66.5% reflectivity at 13.3 nm were produced with net stress values less than 30 MPa.
NTIS
Coatings; Extreme Ultraviolet Radiation; Lithography; Reflectance

19990032126 Department of Energy, Washington, DC USA
Synthesis of Polystyrene-Supported Dithizone Analogues for Use as Chemical Sensors for Heavy Metals
Jenkins, C. W., Department of Energy, USA; King, R. B., Department of Energy, USA; Bresinska, I., Department of Energy, USA; Jul. 31, 1998; 27p; In English
Report No.(s): DE98-058685; WSRC-MS-98-00592; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper describes methods for chemical immobilization of a diarylthiocarbazone unit onto a polystyrene matrix.
NTIS
Polystyrene; Metals; Fiber Optics

19990032172 NASA Lewis Research Center, Cleveland, OH USA
Elevated Temperature Deformation of Cr3Si Alloyed with Mo
Raj, S. V., NASA Lewis Research Center, USA; Whittenberger, J. Daniel, NASA Lewis Research Center, USA; Zeumer, B., Max-Planck-Inst. fuer Eisenforschung, Germany; Sauthoff, G., Max-Planck-Inst. fuer Eisenforschung, Germany; 1998; In English, 14 Feb. 1998, San Antonio, TX, USA; Sponsored by Metallurgical Society, USA
Contract(s)/Grant(s): RTOP 523-21-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
Four-point bend, constant load compressive creep and constant engineering strain rate tests were conducted on arc-melted and powder-metallurgy (PM) processed Cr40Mo30Si30 specimens in the temperature range 1400 and 1700 K. This is a two phase alloy consisting of (CrMo)3Si and (Cr,Mo)5Si3 phases. The PM specimens, which were substantially weaker than the arc-melted materials, exhibited a stress exponent n, of about 2 and an apparent activation energy for creep, Q(sub 3), of 485 kJ/mol. The mechanism in these specimens appeared to be controlled by creep of a glassy phase. In the case of arc-melted specimens for which nis approximately 3 and Q(sub 3) is approximately 430 kJ/mol, the rate-controlling creep mechanism appeared to be that dominant in the (Cr,Mo)5Si3 phase. In this case, it is suggested that the Nabarro creep mechanism, where dislocation climb is controlled

by Bardeen-Herring vacancy sources, is the dominant creep mechanism. Finally, an analysis of the present and literature data on Cr3Si alloyed with Mo appeared to suggest that the creep rate decreases sharply with an increase in the Mo/Si ratio.
Author
Deformation; High Temperature; Creep Properties; Silicon Alloys; Molybdenum; Chromium Alloys; Activation Energy

19990032193 Department of Energy, Washington, DC USA
Use of pulsed high power ion beams to enhance tribological properties of stainless steel, Ti, and Al
Senft, D. C., Department of Energy, USA; Renk, T. J., Department of Energy, USA; Dugger, M. T., Department of Energy, USA; Grabowski, K. S., Department of Energy, USA; Thompson, M. O., Department of Energy, USA; Apr. 30, 1998; 15p; In English; Thin solid films (TSF) and surface and coatings thenology (SCT), USA
Report No.(s): DE98-005487; SAND-98-1166C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Enhanced tribological properties have been observed after treatment with pulsed high power ion beams, which results in rapid melting and resolidification of the surface. The authors have treated and tested 440 C martensitic stainless steel (Fe-17 Cr-1 C). Ti and Al samples were sputter coated and ion beam treated to produce surface alloying. The samples were treated at the RHEPP-I facility at Sandia National Laboratories (0.5 MV, 0.5--1 (micro)s at sample location, <10 J/cm(exp 2), 1-5 (micro)m ion range). They have observed a reduction in size of second phase particles and other microstructural changes in 440 C steel. The hardness of treated 440 C increases with ion beam fluence and a maximum hardness increase of a factor of 5 is obtained. Low wear rates are observed in wear tested of treated 440 C steel. Surface alloyed Ti-Pt layers show improvements in hardness up to a factor of 3 over untreated Ti, and surface alloys of Al-Si result in a hardness increase of a factor of two over untreated Al. Both surface alloys show increased durability in wear testing. Rutherford Backscattering (RBS) measurements show overlayer mixing to the depth of the melted layer. X-ray Diffraction (XRD) and TEM confirm the existence of metastable states within the treated layer. Treated layer depths have been measured from 1--10 (micro)m.
NTIS
Ion Beams; Tribology; Titanium Alloys; Aluminum Alloys; Martensitic Stainless Steels

19990032217 Department of Energy, Washington, DC USA
Waste package degradation expert elicitation panel: Input on the corrosion of CRM alloy C-22
Farmer, J., Department of Energy, USA; Feb. 26, 1998; 23p; In English
Report No.(s): DE98-058283; UCRL-ID-130064; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The overall electrolyte concentration in the NFE environment is expected to be somewhere between 1X and saturated J-13 well water. This covers more than three orders-of-magnitude in chloride anion concentration. The pH of this solution is expected to be somewhere between 5 and 10. Exposed patches of the CRM could see this environment.
NTIS
Radioactive Wastes; Carbon Isotopes; Degradation; Environment Pollution

19990032236 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Formation of a metastable bcc solid solution and decomposition to a C15 Laves phase in melt-spun CrNb(10)Ti(10)
Chen, K. C., Department of Energy, USA; Kotula, P. G., Department of Energy, USA; Chu, F., Department of Energy, USA; Thoma, D. J., Department of Energy, USA; Mar. 31, 1998; 28p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-004386; LA-UR-97-5013; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A metastable, disordered bcc phase has been formed from the melt in a Cr-rich alloy of the Nb-Cr-Ti system, where large volume fractions of the Laves phase would develop under equilibrium solidification conditions. X-ray diffraction (XRD) studies and lattice constant determinations confirm that the melt-spun ribbons contain a bcc phase beyond its terminal solid solution limits. Solidification pathways are proposed based upon metastable and equilibrium phase diagrams. Microstructures have been studied using optical microscopy, scanning electron microscopy (SEM), and transmission electron microscopy (TEM). Cross-sectional TEM reveals tiny, dispersed Laves phase precipitates within the metastable bcc grains near the chill (wheel) side. Away from the wheel, the microstructure changes to a dendritic structure of the bcc and C15 Laves phase. Annealing of the melt-spun ribbons produces a fine, two phase microstructure of the equilibrium phases. Microstructures from the melt- spun and arc melted processing conditions are compared. The micro structural control afforded through this metastable processing route enables a methodology to tailor phase distributions for optimized toughness in Laves phase alloys.
NTIS
Microstructure; Chromium Alloys; Niobium Alloys; Crystal Structure; Decomposition; Dendritic Crystals; Metastable State; Phase Diagrams

19990032237 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA

Microstructures and mechanical properties of sputtered Cu/Cr multilayers

Misra, A., Department of Energy, USA; Kung, H., Department of Energy, USA; Mitchell, T. E., Department of Energy, USA; Jervis, T. R., Department of Energy, USA; Nastasi, M., Department of Energy, USA; Mar. 31, 1998; 8p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-004390; LA-UR-97-5029; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The microstructures and mechanical properties of Cu/Cr multilayers prepared by sputtering onto (l-brace)100(r-brace) Si substrates at room temperature are presented. The films exhibit columnar grain microstructures with nanoscale grain sizes. The interfaces are planar and abrupt with no intermixing, as expected from the phase diagram. The multilayers tend to adopt a Kurdjumov- Sachs (KS) orientation relationship: (l-brace)110(r-brace)Cr // (l-brace) 111(r-brace)Cu, &amp less than 111 &amp amp greater than Cr // &amp less than 110 &amp greater than Cu. The hardness of the multilayered structures, as measured by nanoindentation, increase with decreasing layer thickness for layer thicknesses ranging from 200 nm to 50 nm, whereas for lower thicknesses the hardness of the multilayers is independent of the layer thickness. Dislocation-based models are used to interpret the variation of hardness with layer periodicity. The possible effects of factors such as grain size within the layers, density and composition of films and residual stress in the multilayers are highlighted. Comparisons are made to the mechanical properties of sputtered polycrystalline Cu/Nb multilayers which, like Cu/Cr, exhibit sharp fcc/bcc interfaces with no intermixing and a KS orientation relationship, but have a small shear modulus mismatch.

NTIS

Microstructure; Mechanical Properties; Copper; Chromium; Thick Films; Body Centered Cubic Lattices; Boundary Layers

19990032252 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Thermophysical properties of stainless steel foils

Wilkes, K. E., Department of Energy, USA; Strizak, J. P., Department of Energy, USA; Weaver, F. J., Department of Energy, USA; Besser, J. E., Department of Energy, USA; Smith, D. L., Department of Energy, USA; Oct. 31, 1997; 15p; In English; 24th; Thermal conductivity, USA

Report No.(s): DE98-005046; ORNL/CP-96813; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Evacuated panel superinsulations with very high center-of-panel thermal resistances are being developed for use in refrigerators/freezers. Attainment of high resistances relies upon the maintenance of low vacuum levels by the use of stainless steel vacuum jackets. However, the metal jackets also present a path for heat conduction around the high resistance fillers. This paper presents results of a study of the impact of metal vacuum jackets on the overall thermal performance of vacuum superinsulations when incorporated into the walls and doors of refrigerators/freezers. Results are presented on measurements of the thermophysical properties of several types and thicknesses of stainless steel foils that were being considered for application in superinsulations. A direct electrical heating method was used for simultaneous measurements of the electrical resistivity, total hemispherical emittance, and thermal conductivity of the foils. Results are also presented on simulations of the energy usage of refrigerators/freezers containing stainless-steel-clad vacuum superinsulations.

NTIS

Stainless Steels; Metal Foils; Thermal Insulation; Thermal Conductivity; Electrical Resistivity

19990032390 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA

Mechanical properties of oxide dispersion strengthened (ODS) molybdenum alloys

Bianco, R., Department of Energy, USA; Buckman, R. W., Department of Energy, USA; Mar. 31, 1998; 28p; In English; Sponsored by Minerals, Metals and Materials Society, USA

Report No.(s): DE98-002836; WAPD-T-3175; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Oxide dispersion strengthened molybdenum, Mo-ODS, developed by a proprietary powder metallurgy process, exhibits a creep rupture life at 0.65T(sub m) (1,600 C) of three to five orders of magnitude greater than unalloyed molybdenum, while maintaining ductile fracture behavior at temperatures significantly below room temperature. In comparison, the creep rupture life of the Mo-50Re solid solution strengthened alloy at 1,600 C is only an order of magnitude greater than unalloyed molybdenum. The results of microstructural characterization and thermal stability and mechanical property testing are discussed.

NTIS

Oxide Dispersion Strengthening; Molybdenum Alloys; Creep Properties

19990032401 Department of Energy, Office of Energy Research, Washington, DC USA

APFIM and TEM Study of Ni4Mo Precipitation in a Commercial Ni-28% Mo-1.4% Fe-0.4% Cr wt. % Alloy

Thomson, R. C., Department of Energy, USA; Brown, N., Department of Energy, USA; Bates, J. S., Department of Energy, USA; Russell, K. F., Department of Energy, USA; Miller, M. K., Department of Energy, USA; Feb. 28, 1998; 4p; In English; Microscopy and Microanalysis, 1998, USA

Report No.(s): DE98-005021; ORNL/CP-96510; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ni-Mo alloys containing at least 26 wt.% Mo have a negligible corrosion rate in boiling 10% hydrochloric acid and are therefore used in corrosive environments. A series of commercial Ni-Mo alloys has been developed with subtle variations in chemical composition. These alloys usually contain (approximately) 28 wt.% Mo with additions of up to 5% Fe and Cr. A significant amount of research has been performed to understand the microstructure and properties of these alloys, although most of the effort has concentrated on the Ni-Mo binary system. In some alloys with low Fe and Cr contents, a severe embrittlement problem has been observed due to the formation of the Ni4Mo (D1(sub a)-ordered) phase within the microstructure. This research focuses on a commercial alloy with nominal composition Ni-28% Mo-1.4% Fe-0.4% Cr-0.1% Mn-0.003 wt.% C. The material supplied was a heat treatment coupon which had been attached to a large vessel during fabrication. Assessment of the chemical analysis of the alloy suggested that detrimental phases could be present or might appear during subsequent repair work. Therefore, it was important to assess the microstructural condition of the vessel, and in particular the kinetics of precipitation of Ni4Mo.

NTIS

Corrosion; Nickel Alloys; Molybdenum Alloys

19990032402 Department of Energy, Office of Energy Research, Washington, DC USA

Atom Probe Field Ion Microscopy of Polysynthetically Twinned Titanium Aluminide

Larson, D. L., Department of Energy, USA; Miller, M. K., Department of Energy, USA; Inui, H., Department of Energy, USA; Yamaguchi, M., Department of Energy, USA; Feb. 28, 1998; 4p; In English; Microscopy and Microanalysis, 1998, USA

Report No.(s): DE98-005019; ORNL/CP-96517; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two phase gamma-based TiAl alloys are attractive for structural applications at high temperatures because they possess good elevated-temperature mechanical properties, low density, and good creep and oxidation resistance. The microstructures of these alloys consist of plates of the near equiatomic gamma phase (L1(sub 0)-ordered structure) and the Ti3Al alpha(sub 2) phase (D0(sub 19)-ordered structure). It is of great interest to study the details of the lamellar alpha(sub 2) + gamma microstructure because the interface stability is the key to providing a usable high temperature material. Polysynthetically twinned (PST) TiAl crystals have been developed in order to systematically study the lamellar microstructure. These PST materials contain no high angle grain boundaries and have a single set of aligned lamellar of alpha(sub 2) and gamma phases. Therefore, PST samples facilitate the study of the dependence of mechanical properties on lamellar structure by providing a known, consistent set of aligned lamellar. Previous transmission electron microscopy studies of PST TiAl have shown that Cr and Mo segregation occurs at certain non-coherent gamma/gamma twin boundaries. These studies also found a depletion of aluminum at certain gamma/gamma interfaces, showing 'alpha(sub 2)-like' compositions. However, no evidence was found of even a few unit cells of the D0(sub 19)-ordered structure at the interface by microdiffraction. This paper investigates the feasibility of applying atom probe field ion microscopy to PST TiAl samples and presents some preliminary characterization results from gamma/gamma interfaces in PST TiAl.

NTIS

Intermetallics; Microstructure; Titanium Alloys; Aluminum Alloys; Titanium Aluminides

19990032428 Materials Research Society, Warrendale, PA USA

Materials Research Society, Symposium Proceedings, Volume 521. Porous and Cellular Materials for Structural Applications

Schwartz, Daniel S.; Shih, Donald S.; Evans, Anthony G.; Wadley, Haydn N.; Apr. 15, 1998; 318p; In English; Sponsored in part by contract DAAG55-98-1-9225.

Contract(s)/Grant(s): N00014-98-1-0479

Report No.(s): AD-A360507; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

This volume is a record of the "Porous and Cellular Materials for Structural Applications" symposium, held from April 13-15, at the 1998 MRS Spring Meeting in San Francisco. A diverse and international group of experts was brought together to present and discuss recent developments in the area of porous and cellular materials, including polymer-, ceramic- and metal-based materials. The general focus of the symposium was on porous materials that are being developed, at least in part, for structural applica-

tions. Theoretical aspects of the mechanical behavior of porous and cellular materials were discussed, as well as the specific mechanical properties of a wide variety of solid foam materials. Design principles for the use of solid foams in structures were presented, and a number of promising applications for porous and cellular materials were shown. Papers on the manufacture of solid foams and the production of parts containing solid foams were presented. A significant portion of the symposium was devoted to new porous materials that cannot be classified as foams, such as hollow spheres, hot isostatically compacted and expanded (HICE) materials and GASAR materials. Papers delivered on these novel materials covered their manufacture, properties and prospective uses. The symposium demonstrated that the development and understanding of porous and cellular materials has advanced significantly in the past decade, particularly in the area of porous metallic materials.
DTIC
Porous Materials; Conferences; Mechanical Properties; Structural Design; Foams

19990032510 Department of Energy, Office of Fissile Materials Disposition, Washington, DC USA
Interactions of zircaloy cladding with gallium: 1997 status
Wilson, D. F., Department of Energy, USA; DiStefano, J. R., Department of Energy, USA; King, J. F., Department of Energy, USA; Manneschmidt, E. T., Department of Energy, USA; Strizak, J. P., Department of Energy, USA; Nov. 30, 1997; 35p; In English
Report No.(s): DE98-054238; ORNL/TM-13505; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A four phase program has been implemented to evaluate the effect of gallium in mixed oxide (MOX) fuel derived from weapons grade (WG) plutonium on Zircaloy cladding performance. The objective is to demonstrate that low levels of gallium will not compromise the performance of the MOX fuel system in LWR. This graded, four phase experimental program will evaluate the performance of prototypic Zircaloy cladding materials against: (1) liquid gallium (Phase 1), (2) various concentrations of Ga(sub 2)O3 (Phase 2), (3) centrally heated surrogate fuel pellets with expected levels of gallium (Phase 3), and (4) centrally heated prototypic MOX fuel pellets (Phase 4). This status report describes the results of an initial series of tests for phases 1 and 2. Three types of tests are being performed: (1) corrosion, (2) liquid metal embrittlement (LME), and (3) corrosion mechanical. These tests are designed to determine the corrosion mechanisms, thresholds for temperature and concentration of gallium that may delineate behavioral regimes, and changes in mechanical properties of Zircaloy. Initial results have generally been favorable for the use of WG-MOX fuel. The MOX fuel cladding, Zircaloy, does react with gallium to form intermetallic compounds at greater than or equal 300 C; however, this reaction is limited by the mass of gallium and is therefore not expected to be significant with a low level (in parts per million) of gallium in the MOX fuel. While continued migration of gallium into the initially formed intermetallic compound results in large stresses that can lead to distortion, this is also highly unlikely because of the low mass of gallium or gallium oxide present and expected clad temperatures below 400 C. Furthermore, no evidence for grain boundary penetration by gallium has been observed.
NTIS
Zircaloys (Trademark); Gallium Compounds; Liquid Metals; Intermetallics; Fuel Systems; Cladding

19990032512 Department of Energy, Office of Energy Research, Washington, DC USA
Feasibility of correlating V-Cr-Ti alloy weld strength with weld chemistry ***Final Report***
Grossbeck, M. L., Department of Energy, USA; Odom, R. W., Department of Energy, USA; Jun. 30, 1998; 14p; In English
Report No.(s): DE98-054346; ORNL/M-6554; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The mechanical properties of refractory metals such as vanadium are determined to a large extent by the interstitial impurities in the alloy. In the case of welding, interstitial impurities are introduced in the welding process from the atmosphere and by dissolution of existing precipitates in the alloy itself. Because of the necessity of having an ultra-pure atmosphere, a vacuum chamber or a glove box is necessary. In the V-Cr-Ti system, the titanium serves as a getter to control the concentration of oxygen and nitrogen in solid solution in the alloy. In this project the secondary ion mass spectrometry (SIMS) technique was used to detect, measure, and map the spacial distribution of impurity elements in welds in the alloy V-4Cr-4Ti. An attempt was then made to correlate the concentrations and distributions of the impurities with mechanical properties of the welds. Mechanical integrity of the welds was determined by Charpy V-notch testing. Welds were prepared by the gas-tungsten- arc (GTA) method. Charpy testing established a correlation between weld impurity concentration and the ductile to brittle transition temperature (DBTT) . Higher concentrations of oxygen resulted in a higher DBTT. An exception was noted in the case of a low-oxygen weld which had a high hydrogen concentration resulting in a brittle weld. The concentrations and distributions of the impurities determined by SIMS could not be correlated with the mechanical properties of the welds. This research supports efforts to develop fusion reactor first wall and blanket structural materials.
NTIS
Welded Joints; Titanium Alloys; Chromium Alloys; Vanadium Alloys; Impurities; Mechanical Properties; Refractory Metals; Solid Solutions; Weld Strength

19990032522 Department of Energy, Washington, DC USA

Spallation Modeling in Tantalum

Tonks, D. L., Department of Energy, USA; Hixson, R., Department of Energy, USA; Zurek, A. K., Department of Energy, USA; Thissell, W., Department of Energy, USA; Sep. 30, 1997; 9p; In English; New Models and Numerical Codes for Shock Wave Processes in Condensed Media, USA

Report No.(s): DE98-001541; LA-UR-97-3782; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A gas gun plate impact spallation experiment has been performed on commercial purity rolled tantalum. The shock pressure achieved was about 7 Gpa and was sufficient to induce incipient spallation. The particle velocity was measured at the free surface of the spalled plate, and the spalled sample was recovered and examined metallographically using image analysis. The quantitative image analysis results are being used to develop a damage model. The model is micromechanically based and involves novel void growth and coalescence processes. The 1D characteristics code CHARADE has been used in a preliminary simulation of the VISAR free surface particle velocity record. Implications for ductile damage modeling will be discussed.

NTIS

Tantalum; Impact Tests; Spallation

19990032536 Department of Energy, Washington, DC USA

Evolution of grain size distribution during deformation of superplastic materials

Lesuer, D. R., Department of Energy, USA; Glaser, R., Department of Energy, USA; Syn, C. K., Department of Energy, USA; Oct. 28, 1997; 13p; In English, USA; Sponsored by Minerals, Metals and Materials Society, USA

Report No.(s): DE98-052085; UCRL-JC-128674; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Grain size distribution and its evolution during superplastic deformation has been studied for two materials-ultrahigh carbon steel, which has a two phase microstructure, and a copper alloy, which has a quasi-single phase microstructure. For both materials the distribution of initial grain size is very accurately represented by a lognormal throughout the deformation history. The evolution of the parameters characterizing the log normal distribution have also been studied and found to vary in a systematic manner results. Results can be used to specify the grain size distribution as a function of strain during superplastic deformation and thus should prove useful for computational studies in which grain size distribution is evaluated.

NTIS

Grain Size; Size Distribution; Carbon Steels; Copper Alloys; Plastic Deformation

19990032548 Department of Energy, Washington, DC USA

Analysis of intergranular impurity concentration and the effects on the ductility of copper shaped charge jets

Schwartz, A. J., Department of Energy, USA; Lassila, D. H., Department of Energy, USA; Baker, E. L., Department of Energy, USA; Nov. 20, 1997; 11p; In English; 17th; Ballistics, USA

Report No.(s): DE98-052202; UCRL-JC-129119; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A geometrical analysis based on an assumed tetrakaidecahedron grain shape is applied to determine the relationship among grain size, bulk impurity content, and breakup time in sulfur-doped, high-precision, 81 mm, oxygen-free electronic (ofe) copper shaped charge liners. The calculations determine the number of impurity atoms as a function of grain size, the number of available sites at the intercrystalline defects, and the intercrystalline impurity concentration. Recent experiments have shown that some larger grain size liners with low impurity contents exhibit better ductility than smaller grain size liners with higher impurity concentrations. Within the range of grain sizes and bulk impurity contents in this study, the analysis suggests that the quadruple nodes and triple lines are saturated with impurities. Over this same range of impurities and grain sizes, only partial filling of a monolayer of impurities exists at the grain boundaries. The analysis suggests that breakup time is fundamentally related to grain boundary impurity concentration.

NTIS

Impurities; Concentration (Composition); Copper; Ductility; Shaped Charges; Crystal Structure

19990032554 Department of Energy, Washington, DC USA

Characterization of electron beam melted uranium - 6% niobium ingots

McKoon, R. H., Department of Energy, USA; Oct. 31, 1997; 18p; In English; Electron beam melting, 1997, USA

Report No.(s): DE98-052269; UCRL-JC-128691; CONF-9710176; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A study was undertaken at Lawrence Livermore National Laboratory to characterize uranium, 6 percent niobium ingots produced via electron beam melting, hearth refining and continuous casting and to compare this material with conventional VIM/skull

melt /VAR material. Samples of both the ingot and feed material were analyzed for niobium, trace metallic elements, carbon, oxygen and nitrogen. Ingot samples were also inspected metallographically and via microprobe analysis.
NTIS
Electron Beams; Melting; Uranium; Niobium; Ingots

27
NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.

19990028386 NASA Lewis Research Center, Cleveland, OH USA
Enhanced CARES Software Enables Improved Ceramic Life Prediction
Janosik, Lesley A., NASA Lewis Research Center, USA; 1997; In English; Technology 2007: Technology Transfer, Today for Tomorrow, 22-24 Sep. 1997, Boston, MA, USA; Sponsored by NASA, USA
Contract(s)/Grant(s): RTOP 523-22-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The NASA Lewis Research Center has developed award-winning software that enables American industry to establish the reliability and life of brittle material (e.g., ceramic, intermetallic, graphite) structures in a wide variety of 21st century applications. The CARES (Ceramics Analysis and Reliability Evaluation of Structures) series of software is successfully used by numerous engineers in industrial, academic, and government organizations as an essential element of the structural design and material selection processes. The latest version of this software, CARES/Life, provides a general- purpose design tool that predicts the probability of failure of a ceramic component as a function of its time in service. CARES/Life was recently enhanced by adding new modules designed to improve functionality and user-friendliness. In addition, a beta version of the newly-developed CARES/Creep program (for determining the creep life of monolithic ceramic components) has just been released to selected organizations. Author
Ceramics; Computer Programs; Reliability; Predictions; Creep Properties; Intermetallics

19990028388 UES, Inc., Dayton, OH USA
Development of High Temperature Solid Lubricant Coatings ***Final Report, 15 Aug. 1997 - 14 Aug. 1998***
Bhattacharya, Rabi S.; Keller, Steven; Jan. 29, 1999; 48p; In English
Contract(s)/Grant(s): F49620-97-C-0054
Report No.(s): AD-A359945; UES-P168; AFRL-SR-BL-TR-99-0036; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary research objective of this work was to develop a solid lubricant coating that can function over a broad temperature range. The approach investigated consisted of developing adaptive lubricant coating from materials that undergo chemical change with increasing temperature by reacting together and with the environment. to test this approach, UES and Cleveland State University have conducted experiments to form cesium oxythiotungstate, a high temperature lubricant, on Inconel 718 surface from composite coatings of cesium tungstate and tungsten sulfide. The coatings were deposited by RF sputtering and characterized by X-ray Photoelectron Spectroscopy (XPS). The results indicate that sulfur escapes from the composite coating upon exposure to temperature above 500 C in air. Thus, the desired adaptive lubricant phase, cesium oxythiotungstate could not be formed. However, cesium oxythiotungstate phase has been found to form upon annealing at high temperature in vacuum. The friction coefficients of sputtered cesium oxythiotungstate and cesium tungstate coatings have been measured.
DTIC
Solid Lubricants; Cesium Compounds; Coatings; High Temperature Lubricants; Tungsten Compounds; Sulfur Compounds

19990028483 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Structure and properties of braided sleeve preforms for chemical vapor infiltration
Starr, T. L., Department of Energy, USA; Fiadzo, O. G., Department of Energy, USA; Hablutzel, N., Department of Energy, USA; Apr. 30, 1998; 23p; In English
Report No.(s): DE98-052754; ORNL/SUB-87-00184/07; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In all composites the properties and structure of the reinforcement strongly influence the performance of the material. For some composites, however, the reinforcement also affects the fabrication process itself exerting an additional, second order influence on performance. This is the case for the chemical vapor infiltration (CVI) process for fabrication of ceramic matrix compos-

ites. In this process the matrix forms progressively as a solid deposit, first onto the fiber surfaces, then onto the previous layer of deposit, ultimately growing to fill the inter-fiber porosity. The transport of reactants to the surfaces and the evolved morphology of the matrix depend on the initial reinforcement structure. This structure can vary greatly and is controlled by such factors as fiber size and cross-section, the number of filaments and amount of twist per tow or yarn, and the weave or braid architecture. Often the choice of reinforcement is based on mechanical performance analysis or on the cost and availability of the material or on the temperature stability of the fiber. Given this choice, the composite densification process--CVI--must be optimized to attain a successful material. Ceramic fiber in the form of cylindrical braided sleeve is an attractive choice for fabrication of tube-form ceramic matrix composites. Multiple, concentric layers of sleeve can be placed over a tubular mandrel, compressed and fixed with a binder to form a freestanding tube preform. This fiber architecture is different than that created by layup of plain weave cloth--the material used in most previous CVI development. This report presents the results of the investigation of CVI densification of braided sleeve preforms and the evolution of their structure and transport properties during processing.
NTIS
Composite Materials; Sleeves; Chemical Vapor Infiltration; Ceramic Matrix Composites; Vapor Deposition; Binders (Materials); Densification; Deposits; Fabrication

19990028527 Department of Energy, Office of Energy Research, Washington, DC USA
Solution processing of YBa(sub 2)Cu(sub 3)O(sub 7(minus)x) thin films
Singhal, A., Department of Energy, USA; Paranthaman, M., Department of Energy, USA; Specht, E. D., Department of Energy, USA; Hunt, R. D., Department of Energy, USA; Beach, D. B., Department of Energy, USA; Dec. 31, 1997; 8p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005654; ORNL/CP-98102; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The aim of this work was to develop a non-vacuum chemical deposition technique for YBa(sub 2)Cu(sub 3)O(sub 7(minus)x) (YBCO) coated conductors on rolling-assisted biaxially textured substrates (RABiTS). The authors have chosen the metal-organic decomposition (MOD) and sol-gel precursor routes to grow textured YBCO films. In the MOD process, yttrium 2-ethylhexonate, barium neodecanoate, copper 2-ethylhexonate and toluene were used as the starting reagents. YBCO films processed by the MOD method on SRTiO(sub 3) (100) single crystal substrates were consisted of c and a-axis oriented materials. These films also contained some amount of the random phase. The c and a-axis oriented materials were epitaxial on SRTiO(sub 3) substrates. Films have a T(sub c,onset) of 89K and the best superconducting transition temperature of 63K. Films pyrolyzed at 525 C and subsequently annealed at 780 C in a p(O(sub 2)) of 3.5 (times) 10(sup (minus)4) atm contained YBCO phase predominantly in a-axis orientation. In the sol-gel route, yttrium-isopropoxide, barium metal, copper methoxide and 2-methoxyethanol were used as the starting reagents. Sol-gel YBCO films on SRTiO(sub 3) substrates were epitaxial and c-axis oriented.
NTIS
Barium Oxides; Chemical Engineering; Coatings; Copper Oxides; Superconducting Films; Decomposition; Yttrium Oxides; Thin Films; Sol-Gel Processes; Conferences

19990028627 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Development of ASTM standards in support of advanced ceramics: continuing efforts
Brinkman, C. R., Department of Energy, USA; Feb. 28, 1998; 12p; In English; Turbo ’98: Land, Sea, Air, 1998, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004776; ORNL/CP-97300; CONF-980615; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An update is presented of the activities of the American Society for Testing and Materials (ASTM) Committee C-28 on Advanced Ceramics. Since its inception in 1986, this committee, which has five standard producing subcommittees, has written and published over 32 consensus standards. These standards are concerned with mechanical testing of monolithic and composite ceramics, nondestructive examination, statistical analysis and design, powder characterization, quantitative microscopy, fractography, and terminology. These standards ensure optimum material behavior with physical and mechanical property reproducibility, component reliability, and well-defined methods of data treatment and material analysis for both monolithic and composite materials. An update of recent and current activities as well as possible new areas of standardization work is presented.
NTIS
Ceramics; Standards; Standardization; Statistical Analysis; Terminology

19990028630 Department of Energy, Office of Energy Research, Washington, DC USA

Complex diffusive processes in silicon

Pantelides, S. T., Department of Energy, USA; Ramamoorthy, M., Department of Energy, USA; Maiti, A., Department of Energy, USA; Chisholm, M. F., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Mar. 31, 1998; 10p; In English; Complex Diffusive Process in Silicon Materials, USA

Report No.(s): DE98-005050; ORNL/CP-97134; CONF-960811; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Diffusion is often viewed as a simple process of atoms in an equilibrium configuration making a jump along some path overcoming an energy barrier. First- principles calculations have revealed that even seemingly simple processes can hide enormous complexity. This paper reviews several such cases that have been recently investigated by the authors. In one such case, namely the segregation of As impurities in Si grain boundaries, the theoretical predictions have been complimented and confirmed by high-resolution microscopy.

NTIS

Diffusion; Silicon; Computation; Diffusivity

19990028644 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Molybdenum disilicide composites produced by plasma spraying

Castro, R. G., Department of Energy, USA; Hollis, K. J., Department of Energy, USA; Kung, H. H., Department of Energy, USA; Bartlett, A. H., Department of Energy, USA; May 25, 1998; 9p; In English; 15th; Thermal Spray, USA

Report No.(s): DE98-001610; LA-UR-97-3721; CONF-980533; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The intermetallic compound, molybdenum disilicide (MoSi2) is being considered for high temperature structural applications because of its high melting point and superior oxidation resistance at elevated temperatures. The lack of high temperature strength, creep resistance and low temperature ductility has hindered its progress for structural applications. Plasma spraying of coatings and structural components of MoSi2-based composites offers an exciting processing alternative to conventional powder processing methods due to superior flexibility and the ability to tailor properties. Laminate, discontinuous and in situ reinforced composites have been produced with secondary reinforcements of Ta, Al2O3, SiC, Si3N4 and Mo5Si3. Laminate composites, in particular, have been shown to improve the damage tolerance of MoSi2 during high temperature melting operations. A review of research which as been performed at Los Alamos National Laboratory on plasma spraying of MoSi2 - based composites to improve low temperature fracture toughness, thermal shock resistance, high temperature strength and creep resistance will be discussed.

NTIS

Molybdenum Compounds; Plasma Spraying; Arc Spraying; Heat Resistant Alloys

19990028790 Department of Energy, Washington, DC USA

Preparation and characterization of phenyl-, benzyl-, and phenethyl- substituted polysilsesquioxanes

Schneider, D. A., Department of Energy, USA; Loy, D. A., Department of Energy, USA; Baugher, B. M., Department of Energy, USA; Wheeler, D. R., Department of Energy, USA; Assink, R. A., Department of Energy, USA; Dec. 31, 1998; 4p; In English; 216th, USA; Sponsored by American Chemical Society, USA

Report No.(s): DE98-005900; SAND-98-1400C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Polysilsesquioxanes are a class of siloxane polymers commonly prepared by the hydrolysis and condensation of trialkoxysilanes or trichlorosilanes. From a trifunctional monomer one would expect the organically-modified polymers to be highly crosslinked and insoluble resins. However, while some silsesquioxane monomers with R = H, CH3, or vinyl do form crosslinked polymers capable of forming gels, the majority react to form soluble oligosilsesquioxanes, including discrete polyhedral oligomers, and polymers. Because of their solubility, ladder structures have been proposed. However, viscosity studies by Frye indicate that the polyphenylsilsesquioxane is more likely best represented by a polymer rich in both cyclic structures and branches, but without any regular stereochemistry. In this study, the authors have examined the hydrolysis and condensation polymerizations of phenyltrialkoxysilane, benzyltrialkoxysilane, and 2-phenethyltrialkoxysilane monomers under both acidic and basic conditions. The resulting phenyl, benzyl and phenethyl- substituted polysilsesquioxanes were characterized by H-1, C-13, Si-29 NMR, gel permeation chromatography, and differential scanning calorimetry. The effects of the organic substituent (phenyl, benzyl, phenethyl), alkoxide group (OMe, OEt), catalyst (HCl, NaOH), monomer concentration, and polymer processing on polymer molecular weight and glass transition temperature were determined.

NTIS

Benzene; Phenyls; Hydrolysis

19990028801 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Recent progress in ceramic joining
Loehman, R. E., Department of Energy, USA; Sep. 30, 1998; 7p; In English; 2nd; Science of engineering ceramics, USA
Report No.(s): DE98-005922; SAND-98-1341C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Both fundamental and practical aspects of ceramic joining are understood well enough for many, if not most, applications requiring moderate strengths at room temperature. This paper argues that the two greatest needs in ceramic joining are for techniques to join buried interfaces by selective heating, and methods for joining ceramics for use at temperatures of 800 to 1,200 C. Heating with microwave radiation or with high-energy electron beams has been used to join buried ceramic interfaces, for example SiC to SiC. Joints with varying levels of strength at temperatures of 600 to 1,000 C have been made using four techniques: (1) transient liquid phase bonding; (2) joining with refractory braze alloys; (3) joining with refractory glass compositions; and (4) joining using preceramic polymers. Joint strengths as high as 550 MPa at 1,000 C have been reported for silicon nitride-silicon nitride bonds tested in four-point flexure.
NTIS
Ceramics; Bonding

19990028803 Department of Energy, Washington, DC USA
Characterization of amorphous carbon films grown by pulsed-laser deposition
Siegal, M. P., Department of Energy, USA; Tallant, D. R., Department of Energy, USA; Barbour, J. C., Department of Energy, USA; Provencio, P. N., Department of Energy, USA; Martinez- Miranda, L. J., Department of Energy, USA; Dec. 31, 1998; 12p; In English; High power laser ablation, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): DE98-005917; SAND-98-1327C; CONF-980447; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Amorphous carbon (a-C) films grow via energetic processes such as pulsed- laser deposition (PLD). The cold-cathode electron emission properties of a-C are promising for flat-panel display and vacuum microelectronics technologies. These ultrahard films consist of a mixture of 3-fold and 4-fold coordinated carbon atoms, resulting in an amorphous material with diamond-like properties. The authors study the structures of a-C films grown at room temperature as a function of PLD energetics using x-ray reflectivity, Raman spectroscopy, high- resolution transmission electron microscopy, and Rutherford backscattering spectrometry. While an understanding of the electron emission mechanism in a-C films remains elusive, the onset of emission is typically preceded by conditioning where the material is stressed by an applied electric field. To simulate conditioning and assess its effect, the authors use the spatially- localized field and current of a scanning tunneling microscope tip. Scanning force microscopy shows that conditioning alters surface morphology and electronic structure. Spatially-resolved electron energy loss spectroscopy indicates that the predominant bonding configuration changes from predominantly 4-fold to 3-fold coordination.
NTIS
Amorphous Materials; Carbon; Pulsed Laser Deposition; Crystal Growth

19990028819 Rochester Univ., Dept. of Chemical Engineering, NY USA
Self-Assembly of Ordered Microporous Materials from Rod-Coil Block Copolymers
Jenekhe, Samson a.; Chen, X. L.; Dec. 09, 1998; 19p; In English
Contract(s)/Grant(s): N00014-94-1-0540
Report No.(s): AD-A359381; TR-44; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Rod-coil diblock copolymers in a selective solvent for the coillike polymer self-organize into hollow spherical micelles having diameters of a few micrometers. Long-range, close-packed, self-ordering of the micelles produced highly iridescent periodic microporous materials. Solution cast micellar films consisted of multilayers of hexagonally ordered arrays of spherical holes whose diameter, periodicity, and wall thickness depended on copolymer molecular weight and composition. Addition of fullerenes into the copolymer solutions also regulated the microstructure and optical properties of the microporous films. These results demonstrate the potential of hierarchical self-assembly of macromolecular components for engineering complex two- and three-dimensional periodic and functional mesostructures.
DTIC
Porous Materials; Block Copolymers; Colloids; Rods

19990031846 Department of Energy, Washington, DC USA

Fracture of Hard Thin Films using Nanoindentation and Nanoscratch Techniques: A Materials and Mechanics Approach

Moody, N. R., Department of Energy, USA; Medlin, D., Department of Energy, USA; Hwang, R. Q., Department of Energy, USA; Boehme, D., Department of Energy, USA; Venkataraman, S., Department of Energy, USA; Mar. 19, 1998; 6p; In English; 1998 SEM: Experimental and Applied Mechanics, 1998, USA

Report No.(s): DE98-052525; SAND-98-8504C; CONF-980627; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Thin films are used in many applications where special properties are needed to insure performance and reliability. of particular interest are thin tantalum nitride films. They are used extensively in microelectronic applications because of their long term stability and low thermal coefficient of resistance. They are sputter deposited which produces films with a high structural defect content and high compressive residual stresses both of which can alter the physical and mechanical properties of microelectronic thin films. Although these films are strong heat generators, they exhibit no changes in structure or composition of the interface with aluminum oxide substrates that degrade performance or reliability. However, the use of high power density components is driving a move to replace aluminum oxide with aluminum nitride for greater heat transfer. This replacement substrate creates concern as residual stresses and long-term operation could induce detrimental changes along the thin film interface not observed in aluminum oxide devices. As a result, the authors employed nanoindentation and continuous nanoscratch testing to determine the effects of the intrinsic compressive residual stresses on the properties and fracture resistance of the thin tantalum nitride films. These techniques sample small volumes of material while preserving the production configuration of a free surface. Although nanoscratch tests lack a rigorous derivation of stress distributions and strain energy release rates, good approximations for strain energy release rates can be obtained using mechanics-based models for blister formation where residual stresses dominate interfacial fracture behavior. When combined with scanning and transmission electron microscopy, the results define structure-property relationships and resistance to fracture of these hard films.

NTIS

Microelectronics; Thin Films; Tantalum Nitrides; Reliability; Heat Transfer; Fracture Mechanics

19990031849 Department of Energy, Office of Energy Research, Washington, DC USA

Molecular Dynamics Studies of Thin-Films of Sn on Cu

Ravelo, R., Department of Energy, USA; Aguilar, J., Department of Energy, USA; Baskes, M. I., Department of Energy, USA; Mar. 31, 1998; 8p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-052547; SAND-98-8475C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Using molecular dynamics, the evolution dynamics of Sn on the (111) and (100) surfaces of Cu have been investigated as a function of coverage and temperature. The interaction potentials are described by modified embedded atom method (MEAM) potentials. The calculated diffusion activation energies of Cu in Sn and Sn in Cu agree reasonably well with experimental values. The authors find that the structure of the overlayer depends on the morphology of the substrate and remains stable up 75% of the melting temperature of the substrate, at which diffusion of Sn into the substrate and Cu atoms onto the overlayer is observed.

NTIS

Molecular Dynamics; Thin Films; Tin; Copper

19990031894 Department of Energy, Washington, DC USA

Analysis and modification of amorphous and partially-crystalline thin films

DiNardo, N. J., Department of Energy, USA; Mercer, T. W., Department of Energy, USA; Martinez-Miranda, L. J., Department of Energy, USA; Siegal, M. P., Department of Energy, USA; Friedmann, T. A., Department of Energy, USA; Dec. 31, 1997; 12p; In English, 1997, USA; Sponsored by Materials Research Society, USA

Report No.(s): DE98-005639; SAND-97-1672C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper focuses on several approaches in the characterization and modification of thin films made possible by recent experimental advances. The structural and electronic properties of two model systems are considered as examples: a-tC thin films grown by pulsed laser deposition (PLD) and polyaniline thin films grown by vapor deposition. First, scanning probe microscopies and X-ray scattering are used to investigate the structural aspects of a-tC films as a function of PLD growth conditions. The possible connection of nanoscale surface modification and characterization with electron emission properties is discussed. Second, the results of inelastic scattering spectroscopy and other surface techniques are discussed to obtain information on both interfacial aspects of the growth of polyaniline thin films and microscopic and macroscopic aspects of electrical conductivity upon doping.

Comparisons are made with other studies that address properties of analogous crystalline systems as appropriate. A brief assessment of the broader problem of analyzing these systems are given.
NTIS
Amorphous Materials; Crystallinity; Thin Films

19990031895 Department of Energy, Washington, DC USA
Structural characterization of the thermal evolution of tetrahedrally coordinated amorphous carbon films
Martinez-Miranda, L. J., Department of Energy, USA; Sullivan, J. P., Department of Energy, USA; Friedmann, T. A., Department of Energy, USA; Siegal, M. P., Department of Energy, USA; DiNardo, N. J., Department of Energy, USA; Dec. 31, 1997; 7p; In English, 1997, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005640; SAND-97-1671C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The authors present the results of a post-deposition annealing structural study on amorphous tetrahedrally-coordinated carbon (a-tC) films on Si(100) prepared by pulsed-laser deposition. Films as-deposited and post-annealed at 200, 300, 400, 500 and 600 C, respectively, are studied using combined X-ray reflectivity and low-angle scattering measurements. The scans are fit to the Fresnel equations to obtain values for average film density, film and interface thickness, and film and interface roughness. They observe a correlation between the evolution of film density, roughness and the spacing of quasi-periodic structures in the films as a function of annealing temperature. They relate the evolution of these structural features with previous measurements of the resistivity and the observed stress release in these films.
NTIS
Amorphous Materials; Tetrahedrons; Carbon; Thin Films; Annealing

19990031936 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Polymerization of the cis- and trans-isomers of bis(triethoxysilyl)-2- butene and comparison of their structural properties
Shaltout, R. M., Department of Energy, USA; Loy, D. A., Department of Energy, USA; Carpenter, J. P., Department of Energy, USA; Dorhout, K., Department of Energy, USA; Shea, K. J., Department of Energy, USA; Dec. 31, 1998; 8p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-003552; SAND-98-0970C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The cis and trans isomers of bis-(triethoxysilyl)-2-butene were polymerized by the sol-gel method under various conditions. The trans isomer formed gels under all conditions. The cis isomer formed gels only under basic conditions. Under acidic conditions it formed soluble resins of molecular weight ranging from 88,000 to 180,000 Daltons. Solid state and solution Si-29 Nuclear Magnetic Resonance (NMR) revealed that the trans isomer formed condensed gels, and that the resins formed by the cis isomer contained cyclic monomers and/or ordered oligomers.
NTIS
Polymerization; Isomers; Butenes

19990031937 Department of Energy, Washington, DC USA
Preparation and characterization of aryl-substituted polysilsesquioxanes
Schneider, D. A., Department of Energy, USA; Loy, D. A., Department of Energy, USA; Baugher, B. M., Department of Energy, USA; Wheeler, D. R., Department of Energy, USA; Assink, R. A., Department of Energy, USA; Dec. 31, 1998; 8p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-003551; SAND-98-1421C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Polymerizations of aryltrialkoxysilanes generally afford soluble oligomeric or polymeric aryl-substituted silsesquioxanes. This is in spite of being based on trifunctional precursors capable of forming highly crosslinked and insoluble network polymers. In this study, soluble phenyl, benzyl, and phenethyl- substituted silsesquioxane oligomers and polymers were prepared by hydrolyzing their respective triethoxysilyl precursor with water or aqueous acid. Additional samples of the polymers were prepared by heating the materials at 100 C or 200 C under vacuum in order to drive the condensation chemistry. One sample of polybenzylsilsesquioxane was heated at 200 C with catalytic NaOH. The resulting materials were characterized using solution H-1, C-13, and Si-29 NMR spectroscopy, gel permeation chromatography, and differential scanning calorimetry. of particular interest was the effect of the aryl substituent, and processing conditions on the molecular weight and glass transition temperatures of the polysilsesquioxanes.
NTIS
Polymerization; Aromatic Compounds

19990031946 NASA Glenn Research Center, Cleveland, OH USA

An Additive to Improve the Wear Characteristics of Perfluoropolyether Based Greases

Jones, David G. V., Castrol Industrial North America, USA; Fowzy, Mahmoud A., Castrol Industrial North America, USA; Landry, James F., Castrol Industrial North America, USA; Jones, William R., Jr., NASA Glenn Research Center, USA; Shogrin, Bradley A., AYT Corp., USA; Nguyen, QuynhGiao, AYT Corp., USA; March 1999; 22p; In English, 23-27 May 1999, Las Vegas, NV, USA; Sponsored by Society of Tribologists and Lubrication Engineers, USA

Contract(s)/Grant(s): RTOP 615-63-00

Report No.(s): NASA/TM-1999-209064; NAS 1.15:209064; E-11615; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The friction and wear characteristics of two formulated perfluoropolyether based greases were compared to their non-additive base greases. One grease was developed for the electronics industry (designated as GXL-296A) while the other is for space applications (designated as GXL-320A). The formulated greases (GXL-296B and GXL-320B) contained a proprietary antiwear additive at an optimized concentration. Tests were conducted using a vacuum four-ball tribometer. AISI 52100 steel specimens were used for all GXL-296 tests. Both AISI 52100 steel and 440C stainless steel were tested with the GXL-320 greases. Test conditions included: a pressure less than 6.7 x 10(exp)-4 Pa, a 200N load, a sliding velocity of 28.8 mm/sec (100 rpm) and room temperature (approximately equal to 23 C). Wear rates for each grease were determined from the slope of the wear volume as a function of sliding distance. Both non-additive base greases yielded relatively high wear rates on the order of 10(exp -8) cu mm using AISI 52100 steel specimens. Formulated grease GXL-296B yielded a reduction in wear rate by a factor of approximately 21, while grease GXL-320B had a reduction of approximately 12 times. Lower wear rates (-50%) were observed with both GXL-320 greases using 440C stainless steel. Mean friction coefficients were slightly higher for both formulated greases compared to their base greases. The GXL-296 series (higher base oil viscosity) yielded much higher friction coefficients compared to their GXL-320 series (lower base oil viscosity) counterparts.

Author

Wear Inhibitors; Additives; Greases; Friction; Wear; Loads (Forces); Coefficient of Friction; Abrasion Resistance

19990032034 NASA Glenn Research Center, Cleveland, OH USA

The Effect of Stress and TiC Coated Balls on Lubricant Lifetimes Using a Vacuum Ball-on-Plate Rolling Contact Tribometer

Jones, William R., Jr., NASA Glenn Research Center, USA; Jansen, Mark J., AYT Corp., USA; Helmick, Larry H., Cedarville Coll., USA; Nguyen, QuynhGiao, AYT Corp., USA; Wheeler, Donald R., NASA Glenn Research Center, USA; Voving, Hans J., Centre Suisse d'Electronique et de Microtechnique S..A., Switzerland; March 1999; 12p; In English; 33rd; Aerospace Mechanisms, 19-21 May 1999, Pasadena, CA, USA; Sponsored by NASA Glenn Research Center, USA

Contract(s)/Grant(s): RTOP 615-63-00

Report No.(s): NASA/TM-1999-209055; NAS 1.15:209055; E-11591; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A vacuum ball-on-plate rolling contact tribometer was used to determine the relative lifetimes of a perfluoropolyether (Krytox 143 AC) on 440C stainless steel. The effect of mean Hertzian stresses (0.75, 1.0, 1.5 and 2.0 GPa) and the use of TiC coated balls on lubricant lifetime was studied. Other conditions included: approximately 100 rpm, approximately 50 micrograms of lubricant, an initial vacuum level of less than 1.0 x 1O(exp -8) Torr, and room temperature (approximately 23 C). increasing the mean Hertzian stress from 0.75 to 2.0 GPa results in an exponential decrease in lubricant lifetime for both material combinations. However. substituting a TiC ball for the 440C ball quadrupled lifetime at low stress levels (0.75 and 1.0 GPa) and doubled life at higher stresses (1.5 and 2.0 GPa). The reduced reactivity of the TiC surface with the PFPE lubricant is considered to be the reason for this enhancement. Decreasing lifetime with increasing stress levels correlated well with energy dissipation calculations.

Author

Tribology; Lubricants; Coatings; Reactivity; Augmentation

19990032135 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

MOCVD of field emission phosphors using a liquid delivery system

Moss, T. S., Department of Energy, USA; Espinoza, B. F., Department of Energy, USA; Salazar, K. V., Department of Energy, USA; Dye, R. C., Department of Energy, USA; Mar. 31, 1998; 9p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-004391; LA-UR-97-5025; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Thin film phosphors for field emission displays show the potential to overcome the life-limiting problems that traditional powders face because of their high surface areas. by depositing a fully dense thin film, the surface area can be dramatically reduced, while the electrical and thermal conductivity is increased. Metal organic chemical vapor deposition (MOCVD) offers

the ability to deposit high quality, dense films that are crystalline as deposited and at temperatures low enough to allow for inexpensive glass. Deposition has been produced from mixtures of Y3(tmhd), TEOS, Tb3(tmhd), and O2 using a liquid delivery system. Coatings were shown to be composed of Y, Si, and Tb by x-ray fluorescence, but x-ray diffraction did not show any crystallinity. Excitation using radioluminescence produced a peak in the visible green at approximately 540 nm, indicative of the excitation of a Tb(3+). The morphology of the deposition was smooth, with surface features on the order of one micron and below. Some limited microcracking was also observed from the morphology because of the thermal expansion mismatch.
NTIS
Phosphors; Display Devices; Luminescence; Thin Films; Field Emission; Vapor Deposition

19990032160 Department of Energy, Office of Energy Research, Washington, DC USA
Direct observations of defect structures in optoelectronic materials by Z-contrast STEM
Xin, Y., Department of Energy, USA; Browning, N. D., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Feb. 28, 1998; 5p; In English; Microscopy and Microanalysis, 1998, USA
Report No.(s): DE98-004963; ORNL/CP-97026; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Optoelectronic semiconductor materials have wide and important technological applications. For example, wide gap nitride semiconductors have attracted significant attention recently due to their promising performance as short-wavelength light emitting diodes (LEDs) and blue lasers, while HgCdTe II- VI semiconductors are the most promising candidates for applications as infrared detectors, or large array x-ray or gamma-ray detectors. In this paper, two examples are given to show that high-resolution Z-contrast imaging is an effective technique to determine the atomic structures of defects in these complex semiconductor materials. One interesting issue concerning GaN is that the material is relatively insensitive to the presence of a density of dislocations which is six orders of magnitude higher than that for III-V arsenide and phosphide based LEDs. to develop a fundamental understanding of the properties of the dislocations in GaN, the core structures are determined here by atomic-resolution Z-contrast imaging in a scanning transmission electron microscope (STEM) with a resolution of 0.13 nm. As the Z-contrast image is a convolution between the probe intensity profile and the specimen object function, it is possible to obtain detailed information on the atomic column positions through maximum entropy analysis. For a sphalerite semiconductor, polarity is an important issue, as the asymmetry of the structure gives rise to different physical and chemical properties. Here the authors show that high resolution Z-contrast imaging could be used as an effective method to determine the polarity of II-VI semiconductors without referring to reference samples or image simulations.
NTIS
Gallium Nitrides; Cadmium Tellurides; Mercury Tellurides; Observation; Defects; Optoelectronic Devices; Imaging Techniques; Semiconductors (Materials)

19990032161 Department of Energy, Office of Energy Research, Washington, DC USA
Direct observation of threading dislocations in GaN by high-resolution Z- contrast imaging
Xin, Y., Department of Energy, USA; Browning, N. D., Department of Energy, USA; Sivananthan, S., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Nellist, P. D., Department of Energy, USA; Feb. 28, 1998; 5p; In English; Microscoy and Microanalysis, 1998, USA
Report No.(s): DE98-004962; ORNL/CP-97022; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Wide gap nitride semiconductors have attracted significant attention recently due to their promising performance as short-wavelength light emitting diodes (LEDs) and blue lasers. One interesting issue concerning GaN is that the material is relatively insensitive to the presence of a density of dislocations which is six orders of magnitude higher than that for III-V arsenide and phosphide based LEDs. Although it is well known that these dislocations originate at the film-substrate interface during film growth, thread through the whole epilayer with line direction along (and) amp less than 0001(and)amp greater than and are perfect dislocations with Burgers vectors of a, c, or c+a, the reason why they have such a small effect on the properties of GaN is unclear. to develop a fundamental understanding of the properties of these dislocations, the core structures are studied here by high resolution Z-contrast imaging in a 300 kV VG HB603 scanning transmission electron microscope (STEM) with a resolution of 0.13 nm. As the Z-contrast image is a convolution between the probe intensity profile and the specimen object function, it is possible to obtain more detailed information on the specimen object function, i.e. the structure, through maximum entropy analysis (the maximum entropy technique produces the 'most likely' object function which is consistent with the image).
NTIS
Gallium Nitrides; Observation; Semiconductors (Materials); Imaging Techniques; Dislocations (Materials)

19990032162 Department of Energy, Office of Energy Research, Washington, DC USA

Analyses of interfacial shear debonding in fiber-reinforced ceramic composites

Hsueh, C. H., Department of Energy, USA; Becher, P. F., Department of Energy, USA; Feb. 28, 1998; 4p; In English; 5th; Composites Engineering, USA

Report No.(s): DE98-004961; ORNL/CP-96904; CONF-980717; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An important toughening mechanism in fiber-reinforced ceramic composites is pullout of fibers from the matrix during matrix cracking. This relies on mode II (i.e., shear) debonding at the fiber/matrix interface which can be analyzed using either the strength-based or the energy-based criterion. In the strength- based approach, debonding occurs when the maximum interfacial shear stress induced by the applied load reaches the interfacial shear strength, (tau)(sub s) . In the energy-based approach, a mode II crack propagating along the interface is considered, and debonding occurs when the energy release rate due to crack propagation reaches the interface debond energy, (Gamma)(sub 1). Based on the above two criteria, the applied stress on the fiber to initiate debonding (i.e., the initial debond stress), (sigma)(sub d), can be derived. The first issue considered in the present study is the relation between (tau)(sub s) and (Gamma) (sub 1). Also, for a monolithic ceramic, the tensile strength can be related to its defect size based on the Griffith theory. A question is hence raised as to whether the initial debond stress for fiber pullout in a fiber-reinforced ceramic composite can be related to any defect at the interface.

NTIS

Shear Properties; Composite Materials; Tensile Strength; Shear Stress; Shear Strength; Fiber-Matrix Interfaces; Fiber Pullout; Fiber Composites; Failure; Reinforced Plastics

19990032167 NASA Lewis Research Center, Cleveland, OH USA

Electron Paramagnetic Resonance Imaging of the Spatial Distribution of Free Radicals in PMR-15 Polyimide Resins

Ahn, Myong K., Indiana State Univ., USA; Eaton, Sandra S., Denver Univ., USA; Eaton, Gareth R., Denver Univ., USA; Meador, Mary Ann B., NASA Lewis Research Center, USA; Macromolecules; 1997; Volume 30, No. 26, pp. 8318-8321; In English

Contract(s)/Grant(s): RTOP 523-21-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Prior studies have shown that free radicals generated by heating polyimides above 300 C are stable at room temperature and are involved in thermo-oxidative degradation in the presence of oxygen gas. Electron paramagnetic resonance imaging (EPRI) is a technique to determine the spatial distribution of free radicals. X-band (9.5 GHz) EPR images of PMR-15 polyimide were obtained with a spatial resolution of approximately 0.18 mm along a 2-mm dimension of the sample. In a polyimide sample that was not thermocycled, the radical distribution was uniform along the 2-mm dimension of the sample. For a polyimide sample that was exposed to thermocycling in air for 300 1-h cycles at 335 C, one-dimensional EPRI showed a higher concentration of free radicals in the surface layers than in the bulk sample. A spectral-spatial two-dimensional image showed that the EPR lineshape of the surface layer remained the same as that of the bulk. These EPRI results suggest that the thermo-oxidative degradation of PMR-15 resin involves free radicals present in the oxygen-rich surface layer.

Author

Electron Paramagnetic Resonance; Spatial Distribution; Free Radicals; Polyimide Resins

19990032171 Army Research Lab., Cleveland, OH USA

Design, Operation, and Modeling of a Vertical APCVD Reactor for Silicon Carbide Film Growth

DeAnna, Russell G., Army Research Lab., USA; Fleischman, Aaron J., Case Western Reserve Univ., USA; Zorman, Christian A., Case Western Reserve Univ., USA; Mehregany, Mehran, Case Western Reserve Univ., USA; Journal of Chemical Vapor Deposition; 1998; In English

Contract(s)/Grant(s): DAAH04-95-I-0096; DABT-63-95-C-0070; RTOP 523-21-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An atmospheric pressure chemical vapor deposition (APCVD) reactor utilizing a unique vertical geometry which enables 3C-SiC films to be grown on two, 4-inch diameter Si wafers has been constructed. Contrary to expectations, 3C-SiC films grown in this reactor are thickest at the downstream end of the substrates. to better understand the reason for the thickness distribution on the wafers, an axisymmetric finite-element model of the gas flow in the reactor was constructed. The model uses the ANSYS53 Flowtran package and includes compressible and temperature-dependent fluid properties in laminar or turbulent flow. It does not include reaction chemistry or unsteady flow. The ANSYS53 results predict that the cool, inlet fluid falls through the inlet pipe and the warm, diffuser region like a jet. This jet impinges on top of the susceptor and gets diverted to the reactor side walls, where it flows to the bottom of the reactor, turns, and slowly rises along the face of the susceptor. This may explain why the SiC films

are thickest at the downstream side of the wafers, as gas containing fresh reactants first passes over this region. Modeling results are presented for both one atmosphere and one half atmosphere reactor pressure.
Author
Silicon Carbides; Atmospheric Pressure; Vapor Deposition; Reactors; Films; Turbulent Flow

19990032178 Rochester Univ., Dept. of Chemical Engineering, NY USA
J-Aggregation and Excimer Emission of Anisotropic Solutions and Solid Films of a Liquid Crystalline Conjugated Polymer
Jenekhe, Samson A.; Zhang, Xuejun; Yi, Shujian; Jan. 11, 1999; 19p; In English
Contract(s)/Grant(s): N00014-94-1-0540
Report No.(s): AD-A359383; TR-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Novel features in the absorption and emission processes in liquid crystalline solutions and solvent-cast, self-ordered solid films of a luminescent conjugated polymer are reported. Dominant excimer emission with a minor blue edge aggregate emission were observed in isotropic solid films spin coated from isotropic solutions of polyquinoline. New, strongly red shifted, absorption and excitation bands observed in concentrated solutions exhibiting Smectic C like mesophase evidenced J-aggregation but the emission was characteristic of excimers. J-aggregated chromophores with excimer luminescence and emission dichroism were also observed in solvent-cast ordered solid films. These results demonstrate that excimer emission can arise from J-aggregates or ground state complexes of conjugated polymers. The results also exemplify how the interplay of self-organization and solution processing method can significantly influence the photophysics of conjugated polymers.
DTIC
Emission; Liquid Crystals; Diatomic Molecules; Excimers; Solid Solutions; Polymers

19990032184 NASA Lewis Research Center, Cleveland, OH USA
Surface Diagnostics in Tribology Technology and Advanced Coatings Development
Miyoshi, Kazuhisa, NASA Lewis Research Center, USA; February 1999; 12p; In English; 15th; IMECO, 13-15 Jun. 1999, Osaka, Japan; Sponsored by Society of Instrument and Control Engineers, Japan
Contract(s)/Grant(s): RTOP 523-22-13
Report No.(s): NASA/TM-1999-208527; NAS 1.15:208527; E-11460; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper discusses the methodologies used for surface property measurement of thin films and coatings, lubricants, and materials in the field of tribology. Surface diagnostic techniques include scanning electron microscopy, transmission electron microscopy, atomic force microscopy, stylus profilometry, x-ray diffraction, electron diffraction, Raman spectroscopy, Rutherford backscattering, elastic recoil spectroscopy, and tribology examination. Each diagnostic technique provides specific measurement results in its own unique way. In due course it should be possible to coordinate the different pieces of information provided by these diagnostic techniques into a coherent self-consistent description of the surface properties. Examples are given on the nature and character of thin diamond films.
Author
Surface Properties; Tribology; Electron Diffraction; Atomic Force Microscopy; Transmission Electron Microscopy; X Ray Diffraction

19990032374 Department of Energy, Washington, DC USA
Introduction to USITC enterprise analysis
Ostic, J. K., Department of Energy, USA; Oct. 31, 1997; 35p; In English
Report No.(s): DE98-005302; LA-UR-97-4387; DAMA-G-12-97; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The USA Integrated Textile Complex (USITC) consists of fiber, textile, apparel, and retail firms who manufacture and distribute natural and synthetic fiber products. In today's competitive global economy, USITC companies who team together to form supply chains require relationships which promote responsiveness to consumer demand, encourage business partnerships, and make effective use of resources. These supply chains, or pipelines, are being analyzed to improve time and cost performance. Enterprise analysis is the application of analysis methods and simulation tools to predict integrated performance of these pipelines. Through the use of scenario analysis, various alternatives in pipeline coordination and configuration can be assessed. Simply put, the end result is to design the pipeline so that the product the customer demands is delivered, in the right place, at the right time. In September 1996, industrial participants of the Demand Activated Manufacturing Architecture (DAMA) project completed the Phase 1 pipeline analysis study. The analysis identified opportunities to improve productivity and efficiency among five supply

chain members, and proposed a generic modeling architecture and methodology that, if implemented, would identify actions necessary to improve supply-chain coordination among its members. The architecture and methodology are being pursued during the Phase 2 analysis, which is scheduled to be completed by the end of FY 1997. The goal of the Phase 2 analysis is to propose actionable recommendations to supply-chain members leading to a reduction of pipeline lead-time by 50%.
NTIS
Textiles; Computerized Simulation; Manufacturing

19990032388 Department of Energy, Washington, DC USA
Chemically prepared lead magnesium niobate dielectrics
Tuttle, B. A., Department of Energy, USA; Voigt, J. A., Department of Energy, USA; Sipola, D. L., Department of Energy, USA; Olson, W. R., Department of Energy, USA; Goy, D. M., Department of Energy, USA; Dec. 31, 1998; 11p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-003053; SAND-98-0366C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A chemical solution powder synthesis technique has been developed that produces first, uniform powders of lead magnesium niobate (PMN) with 60 to 80 nm crystallite size. The synthesis technique was based on the dissolution of lead acetate and alkoxide precursors in acetic acid followed by precipitation with oxalic acid/propanol solutions. Lead magnesium niobate ceramics fabricated from these chemically derived powders had smaller, more uniform grain size and higher dielectric constants than ceramics fabricated from mixed oxide powders that were processed under similar thermal conditions. Chem-prep PMN dielectrics with peak dielectric constants greater than 22,000 and polarizations in excess of 29 (micro)C/cm(exp 2) were obtained for 1,100 C firing treatments. Substantial decreases in dielectric constant and polarization were measured for chemically prepared PMN ceramics fired at lower temperatures, consistent with previous work on mixed oxide materials.
NTIS
Lead Acetates; Magnesium; Niobates; Dielectrics

19990032400 Department of Energy, Washington, DC USA
Carbon syntactic foam mechanical properties testing
McEachen, G. W., Department of Energy, USA; Jan. 31, 1998; 21p; In English
Report No.(s): DE98-051592; KCP-613-6043; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This project was started early in the redevelopment of the carbon syntactic foam. The new mixture of carbon microballoons with the APO-BMI resin had not been fully characterized, but that was the actual purpose of this effort. During the forming of the billets for these tests, a problem began to surface; but full understanding of the problem did not evolve until samples were cured and tests were conducted. Material compressive strengths varied between 200 and 990 psi where anything below 700 was rejected. The cure cycle was adjusted in an iterative manner in an attempt to maximize the material strength. The result of this effort was that the material strength was almost doubled and was achieving strengths of 1,500 psi toward the end of the parts produced. As a consequence, some of the strength tests actually run and reported in the text of this report may not reflect data that would be obtained today. The material strength was continuously being improved over the entire year. A complete series of compression test data is reported, but subsequent tensile and flexural strength tests were not repeated. At a time when it is considered that there are no further changes to be incorporated, a repeat of these tests would be warranted. Some development remains to be done on the carbon microballoon material. Improved carbon material is now available and its effect of the material strength should be evaluated.
NTIS
Carbon; Mechanical Properties; Foams; Product Development; Compression Tests

19990032413 NASA Lewis Research Center, Cleveland, OH USA
Creep Life of Ceramic Components Using a Finite-Element-Based Integrated Design Program (CARES/CREEP)
Powers, L. M., Cleveland State Univ., USA; Jadaan, O. M., Wisconsin Univ., USA; Gyekenyesi, J. P., NASA Lewis Research Center, USA; Journal of Engineering for Gas Turbines and Power; January 1998; Volume 120, pp. 162-171; In English; 41st; Transactions of the ASME, 10-13 Jun. 1996, Birmingham, UK; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): ASME Paper 96-GT-369; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The desirable properties of ceramics at high temperatures have generated interest in their use for structural application such as in advanced turbine engine systems. Design lives for such systems can exceed 10,000 hours. The long life requirement necessitates subjecting the components to relatively low stresses. The combination of high temperatures and low stresses typically places failure for monolithic ceramics in the creep regime. The objective of this paper is to present a design methodology for predicting the lifetimes of structural components subjected to creep rupture conditions. This methodology utilizes commercially available

finite element packages and takes into account the time-varying creep strain distributions (stress relaxation). The creep life, of a component is discretized into short time steps, during which the stress and strain distributions are assumed constant. The damage is calculated for each time step based on a modified Monkman-Grant creep rupture criterion. Failure is assumed to occur when the normalized accumulated damage at any point in the component is greater than or equal to unity. The corresponding time will be the creep rupture life for that component. Examples are chosen to demonstrate the Ceramics Analysis and Reliability Evaluation of Structures/CREEP (CARES/CREEP) integrated design program, which is written for the ANSYS finite element package. Depending on the component size and loading conditions, it was found that in real structures one of two competing failure modes (creep or slow crack growth) will dominate. Applications to benchmark problems and engine components are included.
Author
Ceramics; Crack Propagation; Creep Properties; Engine Parts; Failure Modes; Finite Element Method; Stress Relaxation; Stress-Strain Relationships; Structural Design; Creep Rupture Strength

19990032414 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Adhesion of polysilicon microbeams in controlled humidity ambients
Boer, M. P., Department of Energy, USA; Clews, P. J., Department of Energy, USA; Smith, B. K., Department of Energy, USA; Michalske, T. A., Department of Energy, USA; Apr. 30, 1998; 8p; In English, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005456; SAND-98-1034C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors characterize in-situ the adhesion of surface micromachined polysilicon beams subject to controlled humidity ambients. Beams were freed by supercritical CO2 drying. Consistent adhesion results were obtained using a post-treatment in an oxygen plasma which rendered the microbeams uniformly hydrophilic. Individual beam deformations were measured by optical interferometry after equilibration at a given relative humidity (RH). Validation of each adhesion measurement was accomplished by comparing the deformations with elasticity theory. The data indicates that adhesion increases exponentially with RH from 30% to 95%, with values from 1 mJ/m(exp 2) to 50 mJ/m(exp 2). Using the Kelvin equation, the authors show that the data should be independent of RH if a smooth interface is considered. by modeling a rough interface consistent with atomic force microscopy (AFM) data, the exponential trend is satisfactorily explained.
NTIS
Adhesion; Microbeams; Polycrystals; Silicon Polymers; Humidity

19990032505 Department of Energy, Office of Energy Research, Washington, DC USA
Mechanical properties of a structural polyurethane foam and the effect of particulate loading
Goods, S. H., Department of Energy, USA; Neuschwanger, C. L., Department of Energy, USA; Whinnery, L. L., Department of Energy, USA; Apr. 30, 1998; 8p; In English, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-052861; SAND-98-8549C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The room temperature mechanical properties of a closed-cell, polyurethane encapsulant foam have been measured as a function of foam density. Tests were performed on both unfilled and filler reinforced specimens. Over the range of densities examined, the modulus of the unloaded foam could be described by a power-law relationship with respect to density. This power-law relationship could be explained in terms of the elastic compliance of the cellular structure of the foam using a simple geometric model found in the literature. The collapse stress of the foam was also found to exhibit a power-law relationship with respect to density. Additions of an aluminum powder filler increased the modulus relative to the unfilled foam.
NTIS
Polyurethane Foam; Mechanical Properties; Powdered Aluminum; Encapsulating

19990032523 Department of Energy, Washington, DC USA
Thermal, Chemical, and Mechanical Response of Rigid Polyurethane Foam
Hobbs, M. L., Department of Energy, USA; Dec. 31, 1997; 20p; In English; 27th; Combustion, USA
Report No.(s): DE98-001701; SAND-97-3139C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Rigid polyurethane foams are frequently used as encapsulants to isolate and support thermally sensitive components within weapon systems. When exposed to abnormal thermal environments, such as fire, the polyurethane foam decomposes to form products having a wide distribution of molecular weights and can dominate the overall thermal response of the system. Mechanical response of the decomposing foam, such as thermal expansion under various loading conditions created by gas generation, remains a major unsolved problem. A constitutive model of the reactive foam is needed to describe the coupling between mechanical response and chemical decomposition of foam exposed to environments such as fire. Towards this end, a reactive elastic-plastic constitutive model based on bubble mechanics describing nucleation, decomposition chemistry, and elastic/plastic mechanical

behavior of rigid polyurethane foam has been developed. A local force balance, with mass continuity constraints, forms the basis of the constitutive model requiring input of temperature and the fraction of the material converted to gas. This constitutive model provides a stress-strain relationship which is applicable for a broad class of reacting materials such as explosives, propellants, pyrotechnics, and decomposing foams. The model is applied to a block of foam exposed to various thermal fluxes. The model is also applied to a sphere of foam confined in brass. The predicted mechanical deformation of the foam block and sphere are shown to qualitatively agree with experimental observations.
NTIS
Polyurethane Foam; Decomposition; Thermal Expansion; Mechanical Properties

19990032532 Department of Energy, Washington, DC USA
Study of the effects of polishing, etching, cleaving, and water leaching on the UV laser damage of fused silica
Yoshiyama, J., Department of Energy, USA; Genin, F. Y., Department of Energy, USA; Salleo, A., Department of Energy, USA; Thomas, I., Department of Energy, USA; Kozlowski, M. R., Department of Energy, USA; Dec. 23, 1997; 12p; In English; 29th; Optical materials for high power lasers, USA
Report No.(s): DE98-052069; UCRL-JC-129275; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A damage morphology study was performed with a 355 nm Nd:YAG laser on synthetic UV-grade fused silica to determine the effects of post-polish chemical etching on laser-induced damage, compare damage morphologies of cleaved and polished surfaces, and understand the effects of the hydrolyzed surface layer and waste-crack interactions. The samples were polished , then chemically etched in buffered HF solution to remove 45,90,135, and 180 nm of surface material. Another set of samples was cleaved and soaked in boiling distilled water for 1 second and 1 hour. All the samples were irradiated at damaging fluencies and characterized by Normarski optical microscopy and scanning electron microscopy. Damage was initiated as micro-pits on both input and output surfaces of the polished fused silica sample. At higher fluencies, the micro-pits generated cracks on the surface. Laser damage of the polished surface showed significant trace contamination levels within a 50 nm surface layer. Micro-pit formation also appeared after irradiating cleaved fused silica surfaces at damaging fluences. Linear damage tracks corresponding cleaving tracks were often observed on cleaved surfaces. Soaking cleaved samples in water produced wide laser damage tracks.
NTIS
Ultraviolet Lasers; Silica Glass; Polishing; Leaching; Laser Damage; Etching

28
PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

19990028399 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Development of an ultra-safe, ultra-low emissions natural gas fueled school bus ***Final Report***
Kubesh, J. T., Department of Energy, USA; Mar. 31, 1998; 55p; In English, USA
Report No.(s): DE98-004262; NREL/SR-540-23842; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report documents work conducted under Southwest Research Institute (SwRI) Project 03-6871, 'Development of an Ultra-Safe and Low-Emission Dedicated Alternative Fuel School Bus.' The project was sponsored by the National Renewable Energy Laboratory (NREL) under Subcontract No. ZCF-5-13519- 01. This report documents Phase 3 -- Integration and Phase 4 -- Demonstration and serves as the final report for this project. Phase 1 -- Systems Design and Phase 2 -- Prototype Hardware Development were documented in NREL publications TP-425-7609 and TP-425-2 1081, respectively. Several significant areas of work are summarized in this report. Integration of the engine technologies developed under Phase 2 into a production Deere 8.1-L, spark-ignition compressed natural gas engine is detailed, including information on the engine and control system modifications that were made. Federal Test Procedure (FTP) emissions results verifying the ultra-low emissions output of this engine are also included. The informal project goal of producing oxides of nitrogen NO(x) emissions less than or equal to 1.0 g/bhp-hr over the FTP heavy-duty engine cycle was attained. In addition, a test run that resulted in less than one half of the Ultra-Low Emissions Vehicle limit for NO(x) plus non-methane hydrocarbons was obtained. These results were for engine-out (no catalyst) emissions. Results using a catalyst produced very low formaldehyde emissions and virtually zero carbon monoxide and particulate matter emissions. Following these excellent results, a duplicate engine was assembled and integrated into the prototype ultra-safe school

bus, the Envirobus 2000. Many of the new and modified subsystems developed during this project for the engine are considered strong candidates for inclusion into the production Deere 8.1-L gas engine in the near future.
NTIS
Safety; Exhaust Emission; Schools; Natural Gas; Exhaust Gases; Combustion Products; Systems Engineering

19990028475 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Modeling and cold start in alcohol-fueled engines
Markel, A. J., Department of Energy, USA; Bailey, B. K., Department of Energy, USA; May 31, 1998; 62p; In English
Report No.(s): DE98-005250; NREL/TP-540-24180; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Neat alcohol fuels offer several benefits over conventional gasoline in automotive applications. However, their low vapor pressure and high heat of vaporization make it difficult to produce a flammable vapor composition from a neat alcohol fuel during a start under cold ambient conditions. Various methods have been introduced to compensate for this deficiency. In this study, the authors applied computer modeling and simulation to evaluate the potential of four cold-start technologies for engines fueled by near-neat alcohol. The four technologies were a rich combustor device, a partial oxidation reactor, a catalytic reformer, and an enhanced ignition system. The authors ranked the competing technologies by their ability to meet two primary criteria for cold starting an engine at (minus)25 deg C and also by several secondary parameters related to commercialization. Their analysis results suggest that of the four technologies evaluated, the enhanced ignition system is the best option for further development.
NTIS
Alcohols; Ignition Systems; Cold Weather; Automobile Fuels; Commercialization

19990028563 United Technologies Research Center, East Hartford, CT USA
Endothermic fuels autoignition study
Colket, M. B., III, United Technologies Research Center, USA; Spadaccini, L. J., United Technologies Research Center, USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 35-43; In English; See also 19990028559
Contract(s)/Grant(s): F33615-92-C-2295; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

A series of shock-tube experiments was conducted to evaluate the importance of fuel cracking on the autoignition of endothermic-fuel/product mixtures. Ignition delays of ethylene and heptane, typical constituents of a reformed fuel, and simulated reformed endothermic fuel products were measured in dilute mixtures behind reflected shock waves for temperatures in the range 1100-1400 K, pressures of 5-8 atm, and equivalence ratios of 0.5 and 1.0. The experimental data were compared to literature correlations for pure hydrocarbons and hydrogen, and new ignition delay correlations were determined from the combined data sets and expressed as Arrhenius equations for each fuel/mixture. The relative ignition delay times for the different fuels were found to be methane greater than heptane greater than reformed endothermic fuel greater than ethylene greater than hydrogen. The results support the premise that fuel cracking enhances ignition. However, autoignition of the endothermic reaction product mixture is not driven entirely by that of the constituent with the shortest ignition delay (i.e., ethylene or hydrogen). Furthermore, small changes in concentrations of the individual component species are not likely to make large changes in the ignition delay times of the fuel.
Author
Endothermic Fuels; Ethylene; Heptanes; Hydrocarbon Fuels; Propellant Decomposition; Storable Propellants; Ignition; Spontaneous Combustion; Hydrogen Fuels

19990028564 Boeing North American, Inc., Canoga Park, CA USA
Endothermic fuels: A historical perspective
Lander, H. R., Boeing North American, Inc., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 45-60; In English; See also 19990028559; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The term endothermic fuels no longer conjures fear in the aircraft or engine designer. It is no longer viewed as a figment of the imagination of the processing industry. The need for a hydrocarbon fuel for long range hypersonic missions, is attractive because of the volumetric heating value of these petroleum-derived fuels. However, the main characteristic which makes these fuels attractive is their ability to react at certain conditions to absorb heat, thereby cooling the hot structures of the vehicle and also producing highly reactive products. Endothermic fuels evolved from gas turbine fuels (jet fuels) which were developed after World War II. This early research had led to JP-7, used in the SR71, which was the first operational jet fuel specifically defined

for high speed flights (about Mach 3), where cooling temperatures were thought to exceed the limit of liquid hydrocarbon fuels. JP-7 development opened a technology of using fuels to cool into the supercritical regime (>700 F). The operational record of the Mach 3+ SR71 reinforced the need for evaluating the use of liquid jet fuels at even higher speeds. Research, in this area, uncovered conditions where the base fuel would react through the absorption of heat (the endothermic reaction). This paper reviews the evolution of aviation fuels, starting with the first turbojets leading to present and a glimpse at the future. Like any evolutionary process, progress proceeds, sometimes slowly, and leads to a better understanding and eventually a completely different system. Aviation fuel technology has evolved with input from the entire industry, the refiners, engine and aircraft manufacturers and the government.
Author
Endothermic Fuels; Endothermic Reactions; Gas Turbines; Hydrocarbon Fuels; Hypersonics; Jet Engine Fuels; Turbojet Engines; Histories

19990031851 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Investigation of Low-Cost LNG Vehicle Fuel Tank Concepts ***Final Report***
OBrien, J. E., Department of Energy, USA; Siahpush, A., Department of Energy, USA; Feb. 28, 1998; 45p; In English
Report No.(s): DE98-052559; INEEL/EXT-98-00214; GRI-98/0015; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this study was to investigate development of a low-cost liquid natural gas (LNG) vehicle fuel storage tank with low fuel boil-off, low tank pressure, and high safety margin. One of the largest contributors to the cost of converting a vehicle to LNG is the cost of the LNG fuel tank. To minimize heat leak from the surroundings into the low-temperature fuel, these tanks are designed as cryogenic dewars with double walls separated by an evacuated insulation space containing multi-layer insulation. The cost of these fuel tanks is driven by this double-walled construction, both in terms of materials and labor. The primary focus of the analysis was to try to devise a fuel tank concept that would allow for the elimination of the double-wall requirement. Results of this study have validated the benefit of vacuum/MLI insulation for LNG fuel tanks and the difficulty in identifying viable alternatives. The thickness of a non-vacuum insulation layer would have to be unreasonably large to achieve an acceptable non-venting hold time. Reasonable hold times could be achieved by using an auxiliary tank to accept boil-off vapor from a non-vacuum insulated primary tank, if the vapor in the auxiliary tank can be stored at high pressure. The primary focus of the analysis was to try to devise a fuel tank concept that allowed for the elimination of the double-wall requirement. Thermodynamic relations were developed for analyzing the fuel tank transient response to heat transfer, venting of vapor, and out-flow of either vapor or liquid. One of the major costs associated with conversion of a vehicle to LNG fuel is the cost of the LNG fuel tank. The cost of these tanks is driven by the cryogenic nature of the fuel and by the fundamental design requirements of long non-venting hold times and low storage pressure.
NTIS
Liquefied Natural Gas; Fuel Tanks; Storage Tanks; Cryogenic Fluid Storage; Low Cost

19990031979 Department of Energy, Office of Energy Research, Washington, DC USA
Hydrogen Storage in Fullerenes and in an Organic Hydride
Wang, J. C., Department of Energy, USA; Murphy, R. W., Department of Energy, USA; Chen, F. C., Department of Energy, USA; Loutfy, R. O., Department of Energy, USA; Veksler, E., Department of Energy, USA; May 29, 1998; 18p; In English; DOE Hydrogen Program, USA
Report No.(s): DE98-005672; ORNL/CP-98362; CONF-980440; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

While the authors have demonstrated the importance and usefulness of thermal management to the hydrogen storage in fullerenes, their recent effort has concentrated on materials improvement and physical model development. In this paper, they report the results of this effort as follows: (1) Liquid phase hydrogenation of fullerenes indicated that more than 6 wt% capacity can be obtained at 180 C, 350--400 psi; (2) Dehydrogenation of fullerenes hydrides below 225 C was demonstrated using an Ir-based P-C-P pincer complex catalyst; (3) Cyclic hydrogenation and dehydrogenation tests of an organic hydride at 7 wt% capacity were conducted at 180--260 C; and (4) Physical models developed for fullerenes were determined to be applicable to this organic hydride (with much smaller activation energies).
NTIS
Fullerenes; Hydrides

19990032195 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Life cycle inventory of biodiesel and petroleum diesel for use in an urban bus ***Final Report***
Sheehan, J., Department of Energy, USA; Camobreco, V., Department of Energy, USA; Duffield, J., Department of Energy, USA; Graboski, M., Department of Energy, USA; Shapouri, H., Department of Energy, USA; May 31, 1998; 315p; In English
Report No.(s): DE98-005500; NREL/SR-580-24089; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report presents the findings from a study of the life cycle inventories for petroleum diesel and biodiesel. It presents information on raw materials extracted from the environment, energy resources consumed, and air, water, and solid waste emissions generated. Biodiesel is a renewable diesel fuel substitute. It can be made from a variety of natural oils and fats. Biodiesel is made by chemically combining any natural oil or fat with an alcohol such as methanol or ethanol. Methanol has been the most commonly used alcohol in the commercial production of biodiesel. In Europe, biodiesel is widely available in both its neat form (100% biodiesel, also known as B100) and in blends with petroleum diesel. European biodiesel is made predominantly from rapeseed oil (a cousin of canola oil). In the USA, initial interest in producing and using biodiesel has focused on the use of soybean oil as the primary feedstock mainly because the USA is the largest producer of soybean oil in the world.
NTIS
Life (Durability); Diesel Fuels; Urban Transportation; Crude Oil

31
ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

19990028333 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Investigating a reliable covariance control scheme for MDOF systems
Field, R. V., Department of Energy, USA; Bergman, L. A., Department of Energy, USA; Jun. 30, 1998; 7p; In English; American controls, USA
Report No.(s): DE98-004237; SAND-98-0721C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors attempt to extend their previous efforts towards a reliable control scheme that guarantees a specified degree of reliability for civil engineering structures. Herein, a two degree of freedom system is examined. Covariance control techniques are explored to design a compensator that will provide optimal closed loop performance, while satisfying a constraint on system reliability. It was found for the system under examination that a stable control does not exist that also meets the target reliability level. Alternate formulations continue to be investigated.
NTIS
Control Systems Design; Covariance; Degrees of Freedom

19990028397 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Basic parallel sparse eigensolver for structural dynamics
Day, D., Department of Energy, USA; Feb. 03, 1998; 8p; In English; Iteractive methods for large scale eigenvalue problems, USA
Report No.(s): DE98-004289; SAND-98-0410C; CONF-9705260; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this work the basic Finite Element Tearing and Interconnecting (FETI) linear system solver and the PARPACK eigensolver are combined to compute the smallest modes of symmetric generalized eigenvalue problems that arise from structures modeled primarily by solid finite elements. Problems with over one million unknowns are solved. A comprehensive and relatively self-contained description of the FETI method is presented.
NTIS
Eigenvalues; Dynamic Structural Analysis; Parallel Processing (Computers)

19990028400 Department of Energy, Washington, DC USA
System safety assessments combining first principles and model based safety assessment methodologies
Dvorack, M. A., Department of Energy, USA; Jones, T. R., Department of Energy, USA; Carlson, D. D., Department of Energy, USA; Wolcott, J. F., Department of Energy, USA; Sanders, G. A., Department of Energy, USA; Jan. 31, 1998; 7p; In English; ESREL 1998: European safety and reliability, USA
Report No.(s): DE98-004258; SAND-98-0162C; CONF-980621; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In performing assessments of low probability, high consequence systems, it is often preferable to use more than one methodology in order to assure that such systems undergo a thorough assessment. Hence, employing two methodologies in a complementary manner allows the analyst to bring the strongest features of each approach to bear upon the problem. The results of one methodology can be used to crosscheck or better characterize the results of another methodology, with the results being synergized in providing a comprehensive assessment of the system. This paper will briefly describe both the first principles and model based safety assessment methodologies, and will illustrate how both methods are used in a complementary manner in order to perform overall safety assessments of low probability, high consequence engineered systems at Sandia National Laboratories.
NTIS
Safety; Systems Engineering

19990028491 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Computational methods for predicting the response of critical as-built infrastructure to dynamic loads (architectural surety)
Preece, D. S., Department of Energy, USA; Weatherby, J. R., Department of Energy, USA; Attaway, S. W., Department of Energy, USA; Swegle, J. W., Department of Energy, USA; Matalucci, R. V., Department of Energy, USA; Jun. 30, 1998; 51p; In English
Report No.(s): DE98-005875; SAND-98-1240; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Coupled blast-structural computational simulations using supercomputer capabilities will significantly advance the understanding of how complex structures respond under dynamic loads caused by explosives and earthquakes, an understanding with application to the surety of both federal and nonfederal buildings. Simulation of the effects of explosives on structures is a challenge because the explosive response can best be simulated using Eulerian computational techniques and structural behavior is best modeled using Lagrangian methods. Due to the different methodologies of the two computational techniques and code architecture requirements, they are usually implemented in different computer programs. Explosive and structure modeling in two different codes make it difficult or next to impossible to do coupled explosive/structure interaction simulations. Sandia National Laboratories has developed two techniques for solving this problem. The first is called Smoothed Particle Hydrodynamics (SPH), a relatively new gridless method comparable to Eulerian, that is especially suited for treating liquids and gases such as those produced by an explosive. The SPH capability has been fully implemented into the transient dynamics finite element (Lagrangian) codes PRONTO-2D and -3D. A PRONTO-3D/SPH simulation of the effect of a blast on a protective-wall barrier is presented in this paper. The second technique employed at Sandia National Laboratories uses a relatively new code called ALEGRA which is an ALE (Arbitrary Lagrangian-Eulerian) wave code with specific emphasis on large deformation and shock propagation. ALEGRA is capable of solving many shock-wave physics problems but it is especially suited for modeling problems involving the interaction of decoupled explosives with structures.
NTIS
Predictions; Dynamic Loads; Systems Analysis

19990028559 Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
JANNAF Airbreathing Propulsion Subcommittee Meeting, Volume 1, *12 Dec. 1996 - 27 Oct. 1997*
Fry, Ronald S., Editor, Johns Hopkins Univ., USA; Gannaway, Mary T., Editor, Johns Hopkins Univ., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; 117p; In English, 27-30 Oct. 1997, West Palm Beach, FL, USA; See also 19990028560 through 19990028568
Contract(s)/Grant(s): SPO700-97-D-4004
Report No.(s): CPIA-Publ-666-Vol-1; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

This publication, Volume I of four volumes, contains nine unclassified/unlimited distribution papers presented at the 1997 meeting of the JANNAF Airbreathing Propulsion Subcommittee (APS). The JANNAF papers in this volume review advanced and combined cycle technology; hypersonic fuels; ramjet, scramjet and gas turbine design methodologies; and, thermal management for advanced systems.
Author
Engine Design; Gas Turbine Engines; Conferences; Air Breathing Engines; Fuel Combustion; Propulsion System Performance; Propulsion System Configurations

19990031840 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Designing and operating electrostatically driven microengines

Rodgers, M. S., Department of Energy, USA; Sniegowski, J. J., Department of Energy, USA; Miller, S. L., Department of Energy, USA; LaVigne, G. F., Department of Energy, USA; Feb. 28, 1998; 12p; In English; 44th, USA; Sponsored by Instrument Society of America, USA

Report No.(s): DE98-004108; SAND-98-0493C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Microelectromechanical engines that convert the linear outputs from dual orthogonal electrostatic actuators to rotary motion were first developed in 1993. Referred to as microengines, these early devices demonstrated the potential of microelectromechanical technology, but, as expected from any first-of-its-kind device, were not yet optimized. Yield was relatively low, and the 10 micronewtons of force generated by the actuators was not always enough to ensure reliable operation. Since initial development, these engines have undergone a continuous series of significant improvements on three separate fronts: design, fabrication, and electrical activation. Although all three areas will be discussed, emphasis will be on aspects related to mechanical design and generation of the electrical waveforms used to drive these devices. Microtransmissions that dramatically increase torque will also be discussed. Electrostatically driven microengines can be operated at hundreds of thousands of revolutions per minute making large gear reduction ratios feasible; overall ratios of 3,000,000:1 have been successfully demonstrated. Today's microengines have evolved into high endurance (one test device has seen over 7,000,000,000 revolutions), high yield, robust devices that have become the primary actuation source for MicroElectroMechanical Systems (MEMS) at Sandia National Laboratories.

NTIS

Electrostatics; Engines; Design Analysis

19990031987 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

5-level polysilicon surface micromachine technology: Application to complex mechanical systems

Rodgers, M. S., Department of Energy, USA; Sniegowski, J. J., Department of Energy, USA; Jun. 30, 1998; 8p; In English; Solid State Sensor and Actuator, 1998, USA

Report No.(s): DE98-004423; SAND-98-0095C; CONF-980638; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors recently reported on the development of a 5-level polysilicon surface micromachine fabrication process consisting of four levels of mechanical polysilicon plus an electrical interconnect layer. They are reporting on the first components designed for and fabricated in this process. These are demonstration systems, which definitively show that five levels of polysilicon provide greater performance, reliability, and significantly increased functionality. This new technology makes it possible to realize levels of system complexity that have so far only existed on paper, while simultaneously adding to the robustness of many of the individual subassemblies.

NTIS

Miniaturization; Silicon; Machining; Technology Assessment; Procedures; Silicon Polymers; Surface Finishing

19990032394 Motorola, Inc., Advanced Process and Characterization Labs., Tempe, AZ USA

Environmental Technology Initiative: Chemical-Free Cleaning of Semiconductors by the Radiance Process (Trade Name)

Legge, R. N., Motorola, Inc., USA; Thompson, D. L., Motorola, Inc., USA; Convey, D. J., Motorola, Inc., USA; Peterson, J. D., Motorola, Inc., USA; Sep. 1998; 38p; In English

Report No.(s): PB99-126518; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Radiance Process (R) is a patented dry process for removing contaminants from surfaces. It uses light, usually from a pulsed laser and a gas inert to the surface, to entrain released contaminants. The focus of this effort is to assess the applicability of the Radiance Process (R) to the semiconductor industry and its pollution prevention potential. This report discusses the results of experiments conducted to investigate the effectiveness of the Radiance Process (R) in removing chemical mechanical polishing (CMP) slurries from wafers, cleaning flat panel display glass, and removing particles from bare silicon wafers. The results show that post-CMP cleaning using the Radiance Process (R) can restore bare silicon waters to near virgin conditions. For flat panel display material, the Radiance Process (R) was used to clean vendor-supplied float glass substrates used in fabrication. This resulted in reducing total particle counts in excess of 5000 to below 100. These results were equal to, or, in some cases, better than current wet cleaning processes. Contamination not removed by wet processing was further reduced by using the Radiance Process (R). Particle removal from bare silicon wafers was tested in two specific conditions with no statistically significant repeatable removal rates.

NTIS

Photographic Processing; Semiconductors (Materials); Contamination; Chemical Cleaning; Pollution Control

32
COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications. For related information see also 04 Aircraft Communications and Navigation and 17 Space Communications, Spacecraft Communications, Command and Tracking. For search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation.

19990028390 Colorado Univ., Dept. of Electrical and Computer Engineering, Boulder, CO USA
Novel Methods for Simulation of Large Electromagnetic Structures ***Final Report, Jun. 1995 - Jun. 1998***
Dunn, John M.; Feb. 08, 1999; 7p; In English
Contract(s)/Grant(s): F33615-95-C-1756
Report No.(s): AD-A360091; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This is a progress report for the contract "Novel Methods for Simulation of Large electromagnetic Structures". The work conducted under this contract is to develop new methods for speeding up electromagnetic simulation codes. Specifically, wavelet, multipole methods, and non-uniform grid fast Fourier transform methods, are used.

DTIC
Computerized Simulation; Fourier Transformation; Wavelet Analysis; Electromagnetism

19990028394 Department of Energy, Washington, DC USA
Modeling words with subword units in an articulatorily constrained speech recognition algorithm
Hogden, J., Department of Energy, USA; Nov. 20, 1997; 7p; In English
Report No.(s): DE98-004323; LA-UR-97-4848; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The goal of speech recognition is to find the most probable word given the acoustic evidence, i.e. a string of VQ codes or acoustic features. Speech recognition algorithms typically take advantage of the fact that the probability of a word, given a sequence of VQ codes, can be calculated.

NTIS
Words (Language); Algorithms; Speech Recognition

19990028451 Range Commanders Council, White Sands Missile Range, NM USA
Telemetry Standards
Jan. 1999; 364p; In English; Supersedes
Report No.(s): AD-A360563; IRIG-STANDARD-106-99; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The Telemetry Group has prepared this document to foster the compatibility of telemetry transmitting, receiving, and signal processing equipment at the member ranges under the cognizance of the RCC. These standards do not necessarily define the existing capability of any test range, but constitute a guide for the orderly implementation and application of telemetry systems for both the ranges and range users.

DTIC
Telemetry; Signal Processing; Radio Telemetry

19990028656 National Inst. of Standards and Technology, Radio-Frequency Technology Div., Boulder, CO USA
Uncertainty Assessment for Standard Antenna Measurements on the Open Area Test Site
Camell, D. G., National Inst. of Standards and Technology, USA; Sep. 1998; 26p; In English
Report No.(s): PB99-114001; NIST/TN-1507; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Institute of Standards and Technology (NIST) has calibrated electromagnetic compatibility (EMC) antennas using the standard antenna method (SAM) for a number of years. This method uses a standard antenna to precisely measure the electric field. An antenna under test (AUT) is placed where the standard antenna was located to determine its antenna factor. Complete uncertainties are determined for calibrations performed on the open area test site (OATS) facility leading to a statement of uncertainty of the method. The results of this procedure render an expanded uncertainty of + or - 0.78 dB. Assessment of this uncertainty statement and its details are presented in this paper.

NTIS
Antennas; Calibrating; Electromagnetic Compatibility

19990028797 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA

High Intensity Radiated Field External Environments for Civil Aircraft Operating in the USA of America ***Final Report***

Heather, Frederick W., Naval Air Warfare Center, USA; Dec. 1998; 144p; In English

Report No.(s): PB99--126872; NAWCADPAX-98-156-TM; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

NAWCAD Patuxent River, Maryland, was tasked by the FAA to determine the High Intensity Radiated Field (HIRF) levels for civil aircraft operating in the U.S. The electromagnetic field survey will apply to civil aircraft seeking FAA certification under Federal Aviation Regulations (FAR's) Parts 23, 25, 27, and 29.

NTIS

Civil Aviation; Electromagnetic Fields; Radiation Distribution; Electromagnetic Radiation

19990031838 Department of Energy, Washington, DC USA

Range-to-target algorithm for a continuous-wave ground penetrating radar

Caffey, T. W., Department of Energy, USA; Feb. 28, 1998; 6p; In English; 7th; Ground Penetrating Radar, USA

Report No.(s): DE98-004102; SAND-97-1705C; CONF-980526; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Many geologic situations of interest to oil and gas exploration, and to enhanced recover methods, occur in media whose conductivity is too large to permit the use of pulsed GPRs because of severe dispersion. A continuous-wave radar is not affected by dispersion, and can use the round-trip phase, rather than time, to give an estimate of range. In this paper a range to target algorithms is developed for targets which exhibit a crude hyperbolic phase response. This new algorithm minimizes a difference function over both a 2n (pi)-phase interval and a wavelength interval to provide the range. Only crude initial estimates of the electrical parameters of the host media are required to initiate the algorithm. The furnished range may be the distance to some point within the target rather than to a point upon the illuminated surface because the target is three-dimensional and its electrical parameters can take on any value. This error can be reduced by a sufficiently high operating frequency. Examples are given for a variety of targets, media, range and operating frequency using simulated data.

NTIS

Targets; Algorithms; Continuous Wave Radar; Ground Penetrating Radar; Frequency Ranges

19990031884 Department of Energy, Washington, DC USA

Electromagnetic Interactions GEneRalized (EIGER): Algorithm abstraction and HPC implementation

Sharpe, R. M., Department of Energy, USA; Grant, J. B., Department of Energy, USA; Champagne, N. J., Department of Energy, USA; Wilton, D. R., Department of Energy, USA; Jackson, D. R., Department of Energy, USA; Jun. 30, 1998; 9p; In English; 29th; Plasmadynamics and lasers, USA

Report No.(s): DE98-005515; SAND-98-1239C; CONF-980655; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Modern software development methods combined with key generalizations of standard computational algorithms enable the development of a new class of electromagnetic modeling tools. This paper describes current and anticipated capabilities of a frequency domain modeling code, EIGER, which has an extremely wide range of applicability. In addition, software implementation methods and high performance computing issues are discussed.

NTIS

Electromagnetic Interactions; Algorithms; Electromagnetic Fields

19990032118 Defence Research Establishment Ottawa, Ottawa, Ontario Canada

Adaptive Suppression of Interference in HF Surface Wave Radar Using Auxiliary Horizontal Dipole Antennas

Leong, Hank W.; Sep. 1998; 60p; In English

Report No.(s): AD-A359420; DREO-1336; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents the results of a study to evaluate the effectiveness of an adaptive technique using horizontal dipoles to suppress the skywave interference in HF Surface Wave Radar (HFSWR). Four auxiliary horizontal dipole antennas, configured in the form of two separate crosses, were used to form an adaptive system with the vertically polarized antennas (VPA) of a HFSWR system. The outputs of the horizontal dipoles were correlated with the summed output of the VPAs to cancel the interference component in the output of the VPAs. Two slightly different methods were used in the estimation of the correlation coefficients. The first method used the samples at the far ranges of the radar, and the second method used the samples in the range bins close to the range bin selected for the interference suppression. With the first method, the interference-plus-noise power (INP) was reduced by up to 13 dB, and the Bragg-to-interference-plus-noise-ratio (BINR) was increased by up to 21 dB. With the second method, the INP was reduced by up to 17 dB, and the BINR was increased by up to 25 dB. In both methods, we compared the

effectiveness of the adaptive technique using one, two or four horizontal dipole antennas. As expected, we found that the technique was the most effective when all the four horizontal dipoles were used.
DTIC
Search Radar; Dipole Antennas; Signal Processing; Sky Waves; Surface Waves; Radio Frequency Interference

19990032242 Science Applications International Corp., Albuquerque, NM USA
ETE Update: ADS Testing of C4ISR Systems
Marchand, Gary; Dec. 1998; 9p; In English; Presented at the International Test and Evaluation Association Modeling and Simulation Workshop, 7-10 Dec 98.
Report No.(s): AD-A359353; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The End-to-End (ETE) Test, conducted under the auspices of the Department of Defense Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E), is currently developing a synthetic test environment that can be used for future operational testing and doctrinal development. This synthetic test environment will be used initially to conduct developmental and operational testing of the Joint Surveillance Target Attack Radar System (Joint STARS). As designed and built, it may be used to conduct future testing of systems such as the Common Ground Station (CGS), the All Source Analysis System (ASAS), and the Block II Army Tactical Missile System. This paper will describe progress to date, to include the results of our initial operational and developmental tests, lessons learned to date, and experience gained in verifying and validating a synthetic test environment using the Department of Defense Verification, Validation and Accreditation (VV&A) Recommended Practices Guide.
DTIC
Surveillance Radar; Systems Engineering; Missile Systems

19990032243 Science Applications International Corp., Albuquerque, NM USA
VSTARS: A STEP Success Story
Marchand, Gary; Dec. 1998; 8p; In English; Presented at the International Test and Evaluation Association Modeling and Simulation Workshop 7-10 Dec 98.
Report No.(s): AD-A359354; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The End-to-End Test (ETE) is being conducted under the auspices of the Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E). The purpose of the ETE is to investigate the utility of using advanced distributed simulation (ADS) to augment both developmental and operational testing of the Joint Surveillance Target Attack Radar System (STARS). The basic concept behind the ETE is to augment the Joint STARS environment with a virtual environment created by thousands of simulated entities or targets. This virtual environment is imaged by a simulation of the radar system onboard the Joint STARS E-8C aircraft. The simulation environment representing the radar subsystem onboard the E-8C aircraft is called the Virtual Surveillance Target Attack Radar System (VSTARS). VSTARS uses a combination of actual radar subsystem software, simulations of aircraft subsystems, and two near real-time stochastic radar simulations with necessary databases and libraries to simulate the Joint STARS radar subsystem. VSTARS uses early engineering models and simulations and results of early developmental tests to develop a simulation that may be used to assess cost-performance trade-off, technical risk, system maturity, operational effectiveness, suitability, training, mission planning, and employment. The adaptation of VSTARS as the primary training simulation for Joint STARS by the Air Force represents the last step (pun intended) in the application of the simulation, test and evaluation process (STEP) to Joint STARS and establishes the validity of the process in support of the Department of Defense acquisition process.
DTIC
Computerized Simulation; Systems Analysis; Computer Programs; Surveillance Radar; System Effectiveness; Stochastic Processes

19990032244 Communications Research Centre, Ottawa, Ontario Canada
Analysis and Experiments on the Frequency-Independent Strong-Signal Suppressor (FISSS)
Sychaleum, David; Felstead, E. B.; Morin, Gilbert A.; Nov. 1998; 54p; In English
Report No.(s): AD-A359356; CRC-RP-98-006; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The frequency-independent strong-signal suppressor (FISSS) uses nonlinear processing plus cancellation techniques to provide substantial interference suppression. However, only laboratory proof of its operation existed. Although considerable effort went into trying to determine the principle of operation, this principle was not found. In this report, some analytical and simulation attacks on this problem are described. Extensive laboratory measurements were made on devices operating at 1.5 GHz and 10 GHz. The 10 GHz device was combined with direct-sequence spread spectrum, and had measured processing gains of about 12

dB against CW and frequency-modulated single tones. The experimental highlight was the successful suppression of noise interference of between 6 and 12 dB, depending upon the noise bandwidth.
DTIC
Jamming; Frequency Modulation; Nonlinear Systems; Suppressors; Continuous Radiation

19990032245 Joint Advanced Distributed Simulation Joint Test Force, Albuquerque, NM USA
Testing and Training in a Command, Communications, Control, and Intelligence (C3I) Framework
Nov. 03, 1997; 8p; In English
Report No.(s): AD-A359359; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In a theater of operations, the C3I system is the nervous system of the force. It is the collection of pipes, wires, and channels through which information about enemy activity, status of forces, directions, and orders flow. At the component level, C3I systems are Service specific, and tailored to meet Service needs. At the theater level, C3I systems are tailored to meet theater specific needs, and the architecture varies from unified command to unified command. The theater level C3I system must integrate the component level systems into a seamless apparatus which will support theater-wide operations.
DTIC
Command and Control; Architecture (Computers); Education

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ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also 60 Computer Operations and Hardware and 76 Solid-State Physics.

19990028322 Duke Univ., Dept. of Physics, Durham, NC USA
Experimental Control of Chaos ***Final Report, 8 Aug. 1995 - 7 Aug. 1998***
Gauthier, Daniel J.; Dec. 02, 1998; 10p; In English
Contract(s)/Grant(s): DAAH04-95-1-0529
Report No.(s): AD-A358280; ARO-34611.12-PH; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have pursued several research directions on the development, characterization, control and synchronization of nonlinear dynamical systems displaying low dimensional deterministic chaos. The goal of this program is to uncover fundamental issues related to the control and synchronization of nonlinear systems by conducting experiments with novel devices and making precise comparisons between our observations and theoretical predictions. The results of these studies will eventually lead to improved performance of devices that are based on nonlinear systems and to the development of new classes of communication systems. Specifically, we have investigated the control of high speed nonlinear systems including electronic circuits and lasers, and we have explored the conditions under which two nonlinear systems will synchronization in an experimental setting. This research has resulted in 11 publications, 12 invited conference presentations, colloquia, and seminars, 4 distributed conference presentations, one Ph.D. dissertation and several extended contacts with DoD researchers.
DTIC
Continuous Wave Lasers; Chaos; Systems Engineering; Synchronism

19990028334 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
High temperature stable WSi(x) ohmic contacts on GaN
Pearton, S. J., Department of Energy, USA; Donovan, S. M., Department of Energy, USA; Abernathy, C. R., Department of Energy, USA; Ren, F., Department of Energy, USA; Zolper, J. C., Department of Energy, USA; Jun. 30, 1998; 7p; In English; 4th; High temperature electronics, USA
Report No.(s): DE98-004236; SAND-98-0661C; CONF-980622; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have sputter-deposited 500--1200(angstrom) thick WSi(0.45) metallization onto n(+) GaN (n(ge)10(sup 19)cm(exp -3)) doped either during MOCVD growth or by direct Si(+) ion implantation (5 x 10(exp 15) cm(exp -2), 100 keV) activated by RTA at 1,100 C for 30 secs. In the epi samples R(sub C) values of approximately 10(exp -14)(Omega)cm(exp 2) were obtained, and were stable to approximately 1000 C. The annealing treatments up to 600 C had little effect on the WSi(x)/GaN interface, but the (beta)-W2N phase formed between 700--800 C, concomitant with a strong reduction in near-surface crystalline defects in the GaN. Spiking of the metallization down the threading and misfit dislocations was observed at 800 C, extending >5,000(angstrom) in some cases. This can create junction shorting in bipolar or thyristor devices, R(C) values of

<10(exp -6)(Omega) cm(exp 2) were obtained on the implanted samples for 950 C annealing, with values of after 1050 C anneals. The lower R(C) values compared to epi samples appear to be a result of the higher peak doping achieved. The authors observed wide spreads in R(C) values over a wafer surface, with the values on 950 C annealed material ranging from 10(exp -7) to 10(exp -4) (Omega)cm(exp 2). There appear to be highly nonuniform doping regions in the GaN, perhaps associated with the high defect density in heteroepitaxial material, and this may contribute to the variations observed. They believe that near-surface stoichiometry is variable in much of the GaN currently produced due to the relative ease of preferential N2 loss and the common use of H2-containing growth (and cool-down) ambients. Finally, the ohmic contact behavior of WSi(x) on abrupt and graded composition In(x)Al(1-x)N layers has been studied as a function of growth temperature, InN mole fraction (x = 0.5--1) and post WSi(x) deposition annealing treatment.
NTIS
High Temperature; Stability; Gallium Nitrides; Electric Contacts; Silicon Compounds; Tungsten Compounds

19990028409 Michigan Univ., Ann Arbor, MI USA
High-Frequency Microelectronics ***Final Report***
Haddad, George I.; Jun. 1998; 128p; In English
Contract(s)/Grant(s): DAAL03-92-G-0109
Report No.(s): AD-A358353; ARO-30366.326-EL-URI; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

By any measure of productivity and impact this program has been highly productive and has had a major impact on III-V semiconductor technology as evidenced by the number of publications, graduate-student output, interactions with Army laboratories, and other D.O.D., industrial and academic laboratories. This program has provided tremendous leverage by enabling us to attract major programs from other federal agencies and industry. It has also enabled us to establish one of the leading facilities and programs in the nation for research in high-frequency microelectronics through major cost-sharing by the University the State of Michigan and industrial and federal agencies. This program has had and will continue to have a tremendous impact on the field.
DTIC
Microelectronics; Semiconductors (Materials); High Frequencies

19990028464 Department of Energy, Washington, DC USA
Surface-micromachined 1 MHz oscillator with low-noise Pierce configuration
Roessig, T. A., Department of Energy, USA; Howe, R. T., Department of Energy, USA; Pisano, A. P., Department of Energy, USA; Smith, J. H., Department of Energy, USA; Jun. 30, 1998; 7p; In English; Solid state sensor and actuator, 1998, USA
Report No.(s): DE98-004209; SAND-98-0775C; CONF-980638; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A prototype high frequency tuning fork oscillator has been fabricated and tested in an integrated surface micromachining technology. The amplifier circuitry uses a capacitive current detection method, which offers superior noise performance over previous resistive methods. The prototype device has an output frequency of 1.022 MHz and exhibits a noise floor of -88 dBc/Hz at a distance of 500 Hz from the carrier. The dominant source of frequency instability is the nonlinearity introduced by the use of parallel plate actuation.
NTIS
Micromachining; Oscillators; Low Noise

19990028486 NASA Lewis Research Center, Cleveland, OH USA
A Review of the Suppression of Secondary Electron Emission from the Electrodes of Multistage Collectors
Dayton, James A., Jr., NASA Lewis Research Center, USA; 1998; 8p; In English; Discharges and Electrical Insulation in Vacuum, 17-21 Aug. 1998, Einhvon, Netherlands
Contract(s)/Grant(s): RTOP 632-50-5D; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A review is presented of more than 20 years of research conducted at NASA Lewis Research Center on the suppression of secondary electron emission (SEE) for the enhancement of the efficiency of vacuum electron devices with multistage depressed collectors. This paper will include a description of measurement techniques, data from measurements of SEE on a variety of materials of engineering interest and methods of surface treatment for the suppression of SEE. In the course of this work the lowest secondary electron yield ever reported was achieved for ion textured graphite, and, in a parallel line of research, the highest yield was obtained for chemical vapor deposited thin diamond films.
Author
Surface Treatment; Secondary Emission; Accumulators; Electron Emission; Diamond Films; Thin Films

19990028494 Department of Energy, Washington, DC USA

Two-dimensional Green's function Poisson solution appropriate for feature- scale microelectronics simulations

Riley, M. E., Department of Energy, USA; Mar. 31, 1998; 56p; In English

Report No.(s): DE98-004182; SAND-98-0537; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the numerical procedure used to implement the Green's function method for solving the Poisson equation in two-dimensional Cartesian coordinates. The procedure can determine the solution to a problem with any or all of applied voltage boundary conditions, dielectric media, floating (insulated) conducting media, dielectric surface charging, periodic (reflective) boundary conditions, and volumetric space charge. The numerical solution is reasonably fast, and the dimension of the linear problem to be solved is that of the number of elements needed to represent the surfaces, not the whole computational volume. The method of solution is useful in the simulation of plasma particle motion in the vicinity of complex surface structures as found in microelectronics plasma processing applications. A FORTRAN implementation of this procedure is available from the author. NTIS

Microelectronics; Green"S FUNCTIONS; Poisson Equation; Simulation

19990028495 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Electric and hybrid electric vehicles: A technology assessment based on a two-stage Delphi study

Vyas, A. D., Department of Energy, USA; Ng, H. K., Department of Energy, USA; Santini, D. J., Department of Energy, USA; Anderson, J. L., Department of Energy, USA; Dec. 31, 1997; 164p; In English, USA

Report No.(s): DE98-004172; ANL/ESD-36; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

To address the uncertainty regarding future costs and operating attributes of electric and hybrid electric vehicles, a two stage, worldwide Delphi study was conducted. Expert opinions on vehicle attributes, current state of the technology, possible advancements, costs, and market penetration potential were sought for the years 2000, 2010, and 2020. Opinions related to such critical components as batteries, electric drive systems, and hybrid vehicle engines, as well as their respective technical and economic viabilities, were also obtained. This report contains descriptions of the survey methodology, analytical approach, and results of the analysis of survey data, together with a summary of other factors that will influence the degree of market success of electric and hybrid electric vehicle technologies. Responses by industry participants, the largest fraction among all the participating groups, are compared with the overall responses. An evaluation of changes between the two Delphi stages is also summarized. An analysis of battery replacement costs for various types is summarized, and variable operating costs for electric and hybrid vehicles are compared with those of conventional vehicles. A market penetration analysis is summarized, in which projected market shares from the survey are compared with predictions of shares on the basis of two market share projection models that use the cost and physical attributes provided by the survey. Finally, projections of market shares beyond the year 2020 are developed by use of constrained logit models of market shares, statistically fitted to the survey data. NTIS

Electric Hybrid Vehicles; Delphi Method (Forecasting); Technology Assessment; Electric Motor Vehicles

19990028519 Department of Energy, Office of Energy Research, Washington, DC USA

Photocathode research at SLAC

Mulhollan, G., Department of Energy, USA; Clendenin, J., Department of Energy, USA; Garwin, E., Department of Energy, USA; Kirby, R., Department of Energy, USA; Maruyama, T., Department of Energy, USA; Sep. 30, 1997; 4p; In English; 7th; Polarized Gas Targets and Polarized Beams, USA

Report No.(s): DE98-059140; SLAC-PUB-7650; CONF-9708176; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

GaAs based photocathode research at SLAC will be described. Recent efforts have focused on both immediate applications and fundamental photocathode properties. This includes revisiting some old measurements with state-of-the- art instrumentation. NTIS

Photocathodes; Research; Gallium Arsenides

19990028537 Colorado State Univ., Dept. of Physics, Fort Collins, CO USA

Microwave Magnetic Thin Film Soliton Device Physics ***Final Report, 16 Jun. 1995 - 15 Jun. 1998***

Patton, Carl E.; Sep. 22, 1998; 24p; In English

Contract(s)/Grant(s): DAAH04-95-1-0325

Report No.(s): AD-A358331; ARO-33936.16-PH; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

ARO Grant DAAH04-95-1-0325 (P-33936-PH) has supported a research program to explore and implement concepts which utilize microwave magnetic envelope solitons in thin magnetic film device configurations for signal processing at microwave and

millimeter wave frequencies. The work has produced various versions of a soliton oscillator, a soliton switch, and a soliton parametric amplifier. The work has also spawned a number of new device concepts, including an active delay line, several versions of a bistable oscillator, a decay free soliton train generator, and a mode locked spontaneous soliton generator. The switch concept has evolved into a simple phase sensitive on/off switch and a multi-port switch based on the self focusing properties of beam solitons. The original parametric amplifier idea, with the soliton transducer structure inside a microwave cavity, has evolved into a microstrip resonator device with localized parametric pumping and gains in excess of 29 dB. This represents a major breakthrough for magnetic film microwave devices. Work has also proceeded on the study of soliton formation, propagation, reflection, and interaction. A second major breakthrough has been achieved in the direct detection of microwave solitons in magnetic films by Brillouin light scattering.
DTIC
Cavity Resonators; Parametric Amplifiers; Thin Films; Microwave Equipment; Microstrip Devices; Magnetic Films; Solitary Waves

19990028633 Department of Energy, Washington, DC USA
Prototype circuit boards assembled with non-lead bearing solders
Vianco, P. T., Department of Energy, USA; Rejent, J. A., Department of Energy, USA; Apr. 30, 1998; 12p; In English; 3rd; Pacific Rim: Materials and Processing, USA
Report No.(s): DE98-005041; SAND-98-0827C; CONF-980716; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The 91.84Sn-3.33Ag-4.83Bi and 96.5Sn-3.5Ag Pb-free solders were evaluated for surface mount circuit board interconnects. The 63Sn-37Pb solder provided the baseline data. All three solders exhibited suitable manufacturability per a defect analyses of circuit board test vehicles. Thermal cycling had no significant effect on the 91.84Sn-3.33Ag-4.83Bi solder joints. Some degradation in the form of grain boundary sliding was observed in 96.5Sn-3.5Ag and 63Sn- 37Pb solder joints. The quality of the solder joint microstructures showed a slight degree of degradation under thermal shock exposure for all of the solders tested. Trends in the solder joint shear strengths could be traced to the presence of Pd in the solder, the source of which was the Pd/Ni finish on the circuit board conductor features. The higher, intrinsic strengths of the Pb- free solders encouraged the failure path to be located in proximity to the solder/substrate interface where Pd combined with Sn to form brittle PdSn4 particles, resulting in reduced shear strengths.
NTIS
Microstructure; Circuit Boards; Bearing Alloys; Solders; Brazing; Defects; Degradation; Thermal Shock

19990028641 Department of Energy, Washington, DC USA
Precursor ion damage and single event gate rupture in thin oxides
Sexton, F. W., Department of Energy, USA; Fleetwood, D. M., Department of Energy, USA; Shaneyfelt, M. R., Department of Energy, USA; Dodd, P. E., Department of Energy, USA; Hash, G. L., Department of Energy, USA; Feb. 28, 1998; 7p; In English; Nuclear and Space Radiation Effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-005038; SAND-98-0452C; CONF-980705; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Gate oxide electric fields are expected to increase to greater than 5 MV/cm as feature size approaches 0.1 micrometers in advanced integrated circuit (IC) technologies. Work by Johnston, et al. raised the concern that single event gate rupture (SEGR) may limit the scaling of advanced ICs for space applications. SEGR has also been observed in field programmable gate arrays, which rely on thin dielectrics for electrical programming at very high electric fields. The focus of this effort is to further explore the mechanisms for SEGR in thin gate oxides. The authors examine the characteristics of heavy ion induced breakdown and compare them to ion induced damage in thin gate oxides. Further, the authors study the impact of precursor damage in oxides on SEGR threshold. Finally, they compare thermal and nitrided oxides to see if SEGR is improved by incorporating nitrogen in the oxide.
NTIS
Integrated Circuits; Single Event Upsets; Thin Films; Oxides; Damage

19990028647 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Design and characterization of microscale heater structures for test die and sensor applications

Benson, D. A., Department of Energy, USA; Bowman, D., Department of Energy, USA; Filter, W., Department of Energy, USA; Mitchell, R., Department of Energy, USA; Perry, J., Department of Energy, USA; May 31, 1998; 15p; In English; ITHERM '98, USA

Report No.(s): DE98-001387; SAND-97-2893C; CONF-980512; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe a class of microscale heaters fabricated with CMOS processes on silicon wafers. These heaters were designed to produce localized high temperatures above 400 C for test and sensor applications. The temperature levels produced for various input powers and the thermal profiles surrounding the heater for packaged and wafer-level heater structures were studied to guide the placement of microelectronics integrated with the heater structures on the same die. to show the performance of the design, they present resistance sensor measurements, IR temperature profiles, and results from a 3D thermal model of the die. This effort demonstrates that it is possible to successfully operate both a microscale heater and microcircuits on the same die.
NTIS

Design Analysis; Heating Equipment; Fabrication; Electric Equipment

19990028804 Department of Energy, Washington, DC USA

MOCVD growth of AlGaN UV LEDs

Han, J., Department of Energy, USA; Crawford, M. H., Department of Energy, USA; Dec. 31, 1998; 7p; In English; Photonics Taiwan 1998, USA; Sponsored by International Society for Optical Engineering, USA

Report No.(s): DE98-005911; SAND-98-1399C; CONF-980729; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Issues related to the Metalorganic Chemical Vapor Deposition (MOCVD) growth of AlGaN, specifically the gas-phase parasitic reactions among TMG, TMA, and NH3, are studied using an in-situ optical reflectometer. It is observed that the presence of the well-known gas phase adduct (TMA: NH3) could seriously hinder the incorporation behavior of TMGa. Relatively low reactor pressures (30--50 Torr) are employed to grow an AlGaN/GaN SCH QW p-n diode structure. The UV emission at 360 nm (FWHM approximately 10 nm) represents the first report of LED operation from an indium-free GaN QW diode.
NTIS

Metalorganic Chemical Vapor Deposition; Ultraviolet Radiation; Light Emitting Diodes; Aluminum Compounds; Gallium Nitrides

19990028805 Department of Energy, Washington, DC USA

Study of parameters useful for describing plasma-opening switches

Mendel, C. W., Department of Energy, USA; Seidel, D. B., Department of Energy, USA; Rosenthal, S. E., Department of Energy, USA; Dec. 31, 1998; 6p; In English; 12th; High power particle beams, USA

Report No.(s): DE98-005910; SAND-98-0238C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Plasma opening switches (POS) have been used continually and studied since their introduction in 1975. During that period they have performed well for prepulse suppression and sharpening the front of the power pulse. Their use for long conduction time and rapid opening to stand off high voltage in the same POS has met with very limited success. There has been a large theoretical effort involving models and particle-in-cell simulations (PICS), but the connection between theory and experiment has been tenuous at best, and convincing agreement with experiment has been minimal. The authors believe progress toward long conduction and rapid opening would be faster if macroscopic physical parameters describing the physics of the switch were used to compare experiment to simulation. One of these parameters (electron flow impedance) has been used to describe the electrical characteristics of the POS. This parameter provides a good description of both the standard POS (SPOS) and the magnetically controlled POS (MCPOS) because its value is sensibly independent of load current. An additional parameter, the effective mass of the plasma, was measured in one MCPOS experiment. In this article they describe other parameters important to operation of the SPOS and the MCPOS, and parameters important in designing PICS used to study these devices.
NTIS

Plasmas (Physics); Switches

19990028808 Department of Energy, Office of Energy Research, Washington, DC USA

Statistical analysis of low-voltage EDS spectrum images

Anderson, I. M., Department of Energy, USA; Mar. 31, 1998; 3p; In English; 14th; Electron microscopy, USA

Report No.(s): DE98-005718; ORNL/CP-97481; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The benefits of using low ((le)5 kV) operating voltages for energy-dispersive X-ray spectrometry (EDS) of bulk specimens have been explored only during the last few years. This paper couples low-voltage EDS with two other emerging areas of characterization: spectrum imaging of a computer chip manufactured by a major semiconductor company. Data acquisition was performed with a Philips XL30-FEG SEM operated at 4 kV and equipped with an Oxford super-ATW detector and XP3 pulse processor. The specimen was normal to the electron beam and the take-off angle for acquisition was 35 deg. The microscope was operated with a 150 (micro)m diameter final aperture at spot size 3, which yielded an X-ray count rate of approximately 2,000 s(exp -1). EDS spectrum images were acquired as Adobe Photoshop files with the 4 pi plug-in module. (The spectrum images could also be stored as NIH Image files, but the raw data are automatically rescaled as maximum-contrast (0--255) 8-bit TIFF images -- even at 16-bit resolution -- which poses an inconvenience for quantitative analysis.) The 4pi plug-in module is designed for EDS X-ray mapping and allows simultaneous acquisition of maps from 48 elements plus an SEM image. The spectrum image was acquired by re-defining the energy intervals of 48 elements to form a series of contiguous 20 eV windows from 1.25 kV to 2.19 kV. A spectrum image of 450 x 344 pixels was acquired from the specimen with a sampling density of 50 nm/pixel and a dwell time of 0.25 live seconds per pixel, for a total acquisition time of approximately 14 h. The binary data files were imported into Mathematica for analysis with software developed by the author at Oak Ridge National Laboratory. A 400 x 300 pixel section of the original image was analyzed. MSA required approximately 185 Mbytes of memory and approximately 18 h of CPU time on a 300 MHz Power Macintosh 9600.
NTIS
Low Voltage; Imaging Techniques; Dispersing; Multivariate Statistical Analysis; X Ray Spectroscopy

19990028814 Department of Energy, Washington, DC USA
MEMS reliability: The challenge and the promise
Miller, W. M., Department of Energy, USA; Tanner, D. M., Department of Energy, USA; Miller, S. L., Department of Energy, USA; Peterson, K. A., Department of Energy, USA; May 31, 1998; 9p; In English; 4th; The reliability challenge, USA
Report No.(s): DE98-005641; SAND-98-0630C; CONF-980558; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

MicroElectroMechanical Systems (MEMS) that think, sense, act and communicate will open up a broad new array of cost effective solutions only if they prove to be sufficiently reliable. A valid reliability assessment of MEMS has three prerequisites: (1) statistical significance; (2) a technique for accelerating fundamental failure mechanisms, and (3) valid physical models to allow prediction of failures during actual use. These already exist for the microelectronics portion of such integrated systems. The challenge lies in the less well understood micromachine portions and its synergistic effects with microelectronics. This paper presents a methodology addressing these prerequisites and a description of the underlying physics of reliability for micromachines.
NTIS
Microelectromechanical Systems; Reliability

19990028831 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Overview of Modelling and Analysis Techniques for Arbiters and Related Circuits
Xia, F., Newcastle-upon-Tyne Univ., UK; Yakovlev, A., Newcastle-upon-Tyne Univ., UK; Jun. 1998; 24p; In English
Contract(s)/Grant(s): EPSRC-GR/K70715
Report No.(s): PB99--122582; TRS-626; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is an attempt to give an overview of the state of affairs in the literature of the modeling and analysis techniques for arbiters and related flip-flop based circuits. Efforts are especially concentrated on the lower level modelling and analysis of simple circuits using analogue dynamic systems techniques. The phenomenon known as metastability is given particular attention, especially in conjunction with asynchronous operation of the circuits in question.
NTIS
Protocol (Computers); Computer Networks; Circuits

19990031864 NASA Langley Research Center, Hampton,VA USA
Design of the Wind Tunnel Model Communication Controller Board
Wilson, William C., NASA Langley Research Center, USA; Mar. 1999; 119p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 519-20-21-01
Report No.(s): NASA/TM-1999-209108; L-17816; NAS 1.15:209108; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The NASA Langley Research Center's Wind Tunnel Reinvestment project plans to shrink the existing data acquisition electronics to fit inside a wind tunnel model. Space limitations within a model necessitate a distributed system of Application Specific

Integrated Circuits (ASICs) rather than a centralized system based on PC boards. This thesis will focus on the design of the prototype of the communication Controller board. A portion of the communication Controller board is to be used as the basis of an ASIC design. The communication Controller board will communicate between the internal model modules and the external data acquisition computer. This board is based around an Field Programmable Gate Array (FPGA), to allow for reconfigurability. In addition to the FPGA, this board contains buffer Random Access Memory (RAM), configuration memory (EEPROM), drivers for the communications ports, and passive components.
Author
Wind Tunnel Models; Controllers; Wind Tunnel Tests; Design Analysis; Application Specific Integrated Circuits; Computer Aided Design; Control Systems Design; Communication Equipment

19990031986 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Development and optimization of a cryogenic-aerosol-based wafer-cleaning system
Narayanswami, N., Department of Energy, USA; Heitzinger, J., Department of Energy, USA; Patrin, J., Department of Energy, USA; Rader, D., Department of Energy, USA; OHern, T., Department of Energy, USA; Apr. 30, 1998; 15p; In English; 28th; Annual Fine Particle Society Meeting, USA
Report No.(s): DE98-004424; SAND-98-0799C; CONF-980428; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A summary of recent advances in cryogenic-aerosol-based wafer-processing technology for semiconductor wafer cleaning is presented. An argon/nitrogen cryogenic-aerosol-based tool has been developed and optimized for removal of particulate contaminants. The development of the tool involved a combination of theoretical (modeling) and experimental efforts aimed at understanding the mechanisms of aerosol formation and the relation between aerosol characteristics and particle-removal ability. It is observed that the highest cleaning efficiencies are achieved, in general, when the cryogenic aerosol is generated by the explosive atomization of an initially liquid jet of the cryogenic mixture.
NTIS
Integrated Circuits; Cryogenics; Technology Assessment; Procedures; Optimization; Aerosols; Wafers; Surface Finishing; Performance Tests

19990032088 NASA Glenn Research Center, Cleveland, OH USA
Novel Three-Dimensional Vertical Interconnect Technology for Microwave and RF Applications
Goverdhanam, Kavita, Michigan Univ., USA; Simons, Rainee N., DYNACS Engineering Co., Inc., USA; Katehi, Linda P. B., Michigan Univ., USA; March 1999; 8p; In English; MTT-S International Microwave, 13-19 Jun. 1999, Anaheim, CA, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): NAS3-98008; N00014-95-I-0546; RTOP 632-50-5B
Report No.(s): NASA/TM-1999-209043; NAS 1.15:209043; E-11573; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In this paper, novel 3D interconnects suitable for applications in microwave and RF integrated circuit technology have been presented. The interconnect fabrication process and design details are presented. In addition, measured and numerically modeled results of the performance of the interconnects have been shown. The results indicate that the proposed technology has tremendous potential applications in integrated circuit technology. C,
Author
Microwave Circuits; Integrated Circuits; Radio Frequencies

19990032100 Department of Energy, Washington, DC USA
Determination of the uncertainties of reflection coefficient measurements of a microwave network analyzer
Duda, L. E., Department of Energy, USA; Moyer, R. D., Department of Energy, USA; Apr. 30, 1998; 17p; In English; Standards Laboratories (NCSL), 1998, USA
Report No.(s): DE98-004954; SAND-97-2748C; CONF-980721; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A method that calculates the residual uncertainties of a microwave network analyzer for the frequency range of 300 kHz to 50 GHz is described. The method utilizes measurements on NIST-certified standards (such as an airline or load) plus additional measurements to estimate the combined standard uncertainties for measurements using the network analyzer. The uncertainties of the standards are incorporated by means of a Monte Carlo technique. The uncertainties assigned to a network analyzer then

provide the basis for estimating the uncertainties assigned to devices measured using a network analyzer. The results of this method for characterizing network analyzer uncertainties are presented for several connector types.
NTIS
Microwave Equipment; Residues; Procedures; Reflectance; Network Analysis; Electrical Measurement

19990032169 NASA Lewis Research Center, Cleveland, OH USA
Computational Investigation of Experimental Interaction Impedance Obtained by Perturbation for Helical Traveling Wave Tube Structures
Kory, Carol L., Analex Corp., USA; Dayton, James A., Jr., NASA Lewis Research Center, USA; IEEE Transactions on Electron Devices; September 1998; ISSN 0018-9383; Volume 45, No. 9, pp. 2063-2071; In English
Contract(s)/Grant(s): RTOP 632-50-05; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Conventional methods used to measure the cold- test interaction impedance of helical slow-wave structures involve perturbing a helical circuit with a cylindrical dielectric rod placed on the central axis of the circuit It has been shown that the difference in resonant frequency or axial phase shift between the perturbed and unperturbed circuits can be related to the interaction impedance. However, because of the complex configuration of the helical circuit, deriving this relationship involves several approximations. With the advent of accurate three-dimensional (3-D) helical circuit models, these standard approximations can be fully Investigated. This paper addresses the most prominent approximations made in the analysis for measured interaction impedance by Lagerstrom and investigates their accuracy using the 3-D simulation code MAFIA. It is shown that a more accurate value of interaction impedance can be obtained by using 3-D computational methods rather than performing costly and time consuming experimental cold-test measurements.
Author
Computerized Simulation; Traveling Wave Tubes; Wave Propagation; Phase Shift; Dielectrics

19990032179 Texas Univ., Inst. for Advanced Technology, Austin, TX USA
Experiments to Measure Armature Wear, Pt. 1, Wear Measurements on the KJ202 Armature, *Jan. - Dec. 1997*
Stefani, F.; Parker, J.; Aug. 1998; 93p; In English
Contract(s)/Grant(s): DAAA21-93-C-0101
Report No.(s): AD-A359386; IAT.R-0180-Pt. 1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

One of the research objectives of the Hypervelocity Launch group during 1997 was to understand armature wear, with the eventual goal of developing a predictive model. to this end we conducted sixteen experiments to measure wear at various conditions. This report describes the first ten experiments which directly measured wear in a typical ”C-shaped” railgun armature. Section 2 of the report describes the objectives and our state of understanding at the outset of the research. We also comment on some prior work in related areas. Section 3 describes the techniques developed for making in-bore wear measurements. Section 4 summarizes the first ten experiments. Section 5 presents a physical interpretation of the data; our conclusion is based in part on the results of the mechanical wear tests, even though these are not discussed in detail in this report. Four appendices following Section 5 present the data from the experiments in a form that can be used to test models of armature wear.
DTIC
Mechanical Properties; Armatures; Electric Equipment; Wear Resistance; Wear Tests; Railgun Accelerators

19990032251 Department of Energy, Office of Energy Research, Washington, DC USA
Rapid yield learning through optical defect and electrical test analysis
Gleason, S. S., Department of Energy, USA; Tobin, K. W., Department of Energy, USA; Karnowski, T. P., Department of Energy, USA; Lakhani, F., Department of Energy, USA; Feb. 28, 1998; 14p; In English; 23rd; Microlithography, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): DE98-005062; ORNL/CP-96817; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As semiconductor device density and wafer area continue to increase, the volume of in-line and off-line data required to diagnose yield-limiting conditions is growing exponentially. to manage this data in the future, analysis tools will be required that can automatically reduce this data to useful information, e.g., by assisting the engineer in rapid root-cause diagnosis of defect generating mechanisms. In this paper, the authors describe a technology known as Spatial Signature Analysis (SSA) and its application to both optically-detected defect data as well as electrical test (e-test) bin data. The results of a validation study are summarized that demonstrate the effectiveness of the SSA approach on optical defect wafermaps through field- testing at three semiconductor manufacturing sites on ASIC, DRAM and SRAM products. This method has been extended to analyze and interpret electrical test data and to provide a pathway for correlation of this data with in-line optical measurements. The image processing-based, fuzzy classifier system used for optical defect SSA has been adopted and applied to e-test binmaps to interpret and rapidly identify char-

acteristic patterns, or signatures, in the binmap data that are uniquely associated with the manufacturing process. An image of the binmap is created, and features such as mass, simple moments, and invariant moments are extracted and presented to a pair-wise, fuzzy, k-NN classifier. The preliminary performance results show an 84% correct e-test signature classification rate, even under sub-optimal training conditions.
NTIS
Yield; Optical Measurement; Signature Analysis; Semiconductor Devices; Defects

19990032365 Department of Energy, Office of Energy Research, Washington, DC USA
High-power extreme ultraviolet source based on gas jets
Kubiak, G. D., Department of Energy, USA; Bernardez, L. J., Department of Energy, USA; Krenz, K., Department of Energy, USA; Mar. 31, 1998; 11p; In English; 23rd; Microlithography, USA
Report No.(s): DE98-052512; SAND-98-8511C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report on the development of a high power laser plasma Extreme Ultraviolet (EUV) source for Extreme Ultraviolet Lithography. The source is based on the plasma emission of a recycled jet beam of large Xe clusters and produces no particulate debris. The source will be driven by a pulsed laser delivering 1,500 W of focused average power to the cluster jet target. To develop condensers and to optimize source performance, a low power laboratory cluster jet prototype has been used to study the spectroscopy, angular distributions, and EUV source images of the cluster jet plasma emission. In addition, methods to improve the reflectance lifetimes of nearby plasma facing condenser mirrors have been developed. The resulting source yields EUV conversion efficiencies up to 3.8% and mirror lifetimes of 10(exp 9) plasma pulses.
NTIS
Gas Jets; Extreme Ultraviolet Radiation; Technology Assessment; High Power Lasers; Plasmas (Physics)

19990032372 Department of Energy, Washington, DC USA
Design and experimental results on a terawatt magnetically controlled plasma opening switch
Savage, M. E., Department of Energy, USA; Simpson, W. W., Department of Energy, USA; Mendel, C. W., Department of Energy, USA; McDaniel, D. H., Department of Energy, USA; Levine, J. S., Department of Energy, USA; May 31, 1998; 66p; In English
Report No.(s): DE98-005450; SAND-98-0704; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The magnetically controlled plasma opening switch (MCPOS) is an advanced plasma opening switch that utilizes magnetic fields to improve operation. Magnetic fields always dominate terawatt, pulsed power plasma opening switches. For that reason, the MCPOS uses controlled applied magnetic fields with magnitude comparable to the self-magnetic field of the storage inductor. One applied field holds the plasma in place while energy accumulates in the storage inductor, then another applied field pushes the plasma away from the cathode to allow energy to flow downstream. Over a ten month period, an MCPOS was designed, built, and tested on DECADE Module 2 at Physics International. The peak drive current was 1.8 MA in 250 ns. The output parameters were up to 1 MA into an electron beam load. The radiation temporal pulse width averaged 60 nanoseconds full-width at half-maximum. The peak load voltage ranged from one to two megavolts. The experiments demonstrated efficient power flow through a long, low-impedance magnetically insulated transmission line between the magnetically controlled plasma opening switch and the load.
NTIS
Plasma Control; Magnetic Fields; Switches; Plasmas (Physics)

19990032384 Department of Energy, Washington, DC USA
Direct-write fabrication of integrated, multilayer ceramic components
Dimos, D., Department of Energy, USA; Yang, P., Department of Energy, USA; Mar. 31, 1998; 6p; In English; 48th; Electronic Component and Technology (ECTC), USA
Report No.(s): DE98-003402; SAND-98-0690C; CONF-980550; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The need for advanced (electronic) ceramic components with smaller size, greater functionality, and enhanced reliability requires the ability to integrate electronic ceramics in complex 3-D architectures. However, traditional tape casting and screen printing approaches are poorly suited to the requirements of rapid prototyping and small lot manufacturing. to address this need, the authors are developing a direct write approach for fabricating highly integrated, multilayer components using a micropen to deposit slurries in precise patterns. This approach provides the ability to fabricate multifunctional, multimaterial integrated

ceramic components (MMICCs) in an agile and rapid way, and has been used to make integrated passive devices such RC filters, inductors, and voltage transformers.
NTIS
Fabrication; Ceramics; Electric Potential

19990032385 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
A.c. transport and collective excitation in a quantum point contact
Berman, G. P., Department of Energy, USA; Doolen, G. D., Department of Energy, USA; Mainieri, R., Department of Energy, USA; Aronov, I. E., Department of Energy, USA; Campbell, D. K., Department of Energy, USA; Feb. 28, 1998; 10p; In English; 2nd; Surfaces and Interfaces of Mesoscopic Devices, USA
Report No.(s): DE98-003366; LA-UR-97-4751; CONF-971230; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors calculate the a.c.-admittance of a two dimensional quantum point contact (QPC) using a Boltzmann-like kinetic equation derived for the partial Wigner distribution function. An integral equation for a potential inside a QPC is solved numerically. The dependence of the admittance on the frequency of the a.c. field is found in a wide frequency range (omega) (approx) 0--50 GHz. The contribution to the imaginary part of the admittance due to the quantum capacitance and inductance is numerically calculated. It is shown that the crossover from localized parameters--quantum capacitance and inductance--to distributed behavior takes place at (omega) (approximately) 10 GHz. A transition from 2D plasmons to quasi-1D plasmons is analyzed as a function of two dimensionless parameters: k(sub x)d(sub 0) (where k(sub x) is the longitudinal wave vector, and d(sub 0) is the width of the QPC), and the number of open electron channels, N.
NTIS
Excitation; Quantum Mechanics; Electric Contacts; Electrical Impedance

19990032389 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
High gain GaAs photoconductive semiconductor switches: Switch longevity
Loubriel, G. M., Department of Energy, USA; Zutavern, F. J., Department of Energy, USA; Mar, A., Department of Energy, USA; Dec. 31, 1998; 4p; In English
Report No.(s): DE98-002958; SAND-98-0475C; CONF-980665; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Optically activated, high gain GaAs switches are being tested for many different pulsed power applications that require long lifetime (longevity). The switches have p and n contact metallization (with intentional or unintentional dopants) configured in such a way as to produce p-i-n or n-i-n switches. The longevity of the switches is determined by circuit parameters and by the ability of the contacts to resist erosion. This paper will describe how the switches performed in test-beds designed to measure switch longevity. The best longevity was achieved with switches made with diffused contacts, achieving over 50 million pulses at 10 A and over 2 million pulses at 80 A.
NTIS
Photoconductivity; Gallium Arsenides; High Gain; Semiconductors (Materials); Switches; Life (Durability)

19990032392 Department of Energy, Washington, DC USA
Trigger circuits for the PHENIX electromagnetic calorimeter
Frank, S. S., Department of Energy, USA; Britton, C. L., Department of Energy, USA; Winterberg, A. L., Department of Energy, USA; Young, G. R., Department of Energy, USA; Nov. 30, 1997; 8p; In English
Report No.(s): DE98-001896; ORNL/CP-95618; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Monolithic and discrete circuits have been developed to provide trigger signals for the PHENIX electromagnetic calorimeter detector. These trigger circuits are deadtimeless and create overlapping 4 by 4 energy sums, a cosmic muon trigger, and a 144 channel energy sum. The front end electronics of the PHENIX system sample the energy and timing channels at each bunch crossing (BC) but it is not known immediately if this data is of interest. The information from the trigger circuits is used to determine if the data collected is of interest and should be digitized and stored or discarded. This paper presents details of the design, issues affecting circuit performance, characterization of prototypes fabricated in 1.2 (micro)m Orbit CMOS, and integration of the circuits into the EMCal electronics system.
NTIS
Trigger Circuits; Calorimeters; Electromagnetism

19990032506 Department of Energy, Office of Energy Research, Washington, DC USA

Million-line failure distributions for narrow interconnects

Bartelt, M. C., Department of Energy, USA; Hoyt, J. J., Department of Energy, USA; Bartelt, N. C., Department of Energy, USA; Dike, J. J., Department of Energy, USA; Wolfer, W. G., Department of Energy, USA; Dec. 31, 1997; 10p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-052863; SAND-98-8554C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors examine the distribution of failure times in a simple and computationally efficient, yet reasonably authentic, model of interconnect reliability that allows consideration of statistically significant samples. The model includes an approximate description of the distribution of grain sizes and texture in narrow interconnects, an effective treatment of stress evolution associated with mass transport along grain boundaries, and local relaxation of stresses due to void formation. Failure time distributions for populations of idealized structures are analyzed to aid in interpretation of model behavior.

NTIS

Connectors; Failure; Textures

19990032561 NASA Lewis Research Center, Cleveland, OH USA

Perimeter Governed Minority Carrier Lifetimes in 4H-SiC p+n Diodes Measured by Reverse Recovery Switching Transient Analysis

Neudeck, Philip G., NASA Lewis Research Center, USA; Journal of Electronic Materials: Special Issue Paper; 1998; Volume 27, No. 4, pp. 317-323; In English

Contract(s)/Grant(s): RTOP 523-21-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Minority carrier lifetimes in epitaxial 4H-SiC p-n junction diodes were measured via an analysis of reverse recovery switching characteristics. Behavior of reverse recovery storage time (t(sub s)) as a function of initial ON-state forward current (I(sub f)) and OFF-state reverse current (I(sub R)) followed well-documented trends which have been observed for decades in silicon p-n rectifiers. Average minority carrier (hole) lifetimes (tau(sub p)) calculated from plots of t(sub s) vs I(sub R)/I(sub F) strongly decreased with decreasing device area. Bulk and perimeter components of average hole lifetimes were separated by plotting tau(sub p) as a function of device perimeter-to-area ratio (P/A). This plot reveals that perimeter recombination is dominant in these devices, whose areas are all less than 1 square mm. The bulk minority carrier (hole) lifetime extracted from the 1/Tau(sub p) vs P/A plot is approximately 0.7 microns, well above the 60 ns to 300 ns average lifetimes obtained when perimeter recombination effects are ignored in the analysis. Given the fact that there has been little previous investigation of bipolar diode and transistor performance as a function of perimeter-to-area ratio, this work raises the possibility that perimeter recombination may be partly responsible for poor effective minority carrier lifetimes and limited performance obtained in many previous SiC bipolar junction devices.

Author

Bipolar Transistors; Carrier Lifetime; Junction Diodes; Minority Carriers; P-N Junctions; Holes (Electron Deficiencies); Semiconductors (Materials); Silicon Carbides

34
FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling. For related information see also 02 Aerodynamics and 77 Thermodynamics and Statistical Physics.

19990028331 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Diffusion with condensation and evaporation in porous media

Gu, L., Department of Energy, USA; Plumb, O. A., Department of Energy, USA; Ho, C. K., Department of Energy, USA; Webb, S. W., Department of Energy, USA; Mar. 31, 1998; 10p; In English; Thermophysics and heat transfer, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): DE98-004240; SAND-98-0618C; CONF-980610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Vapor phase transport in porous media is important in a number of environmental and industrial processes: soil moisture transport, vapor phase transport in the vadose zone, transport in the vicinity of buried nuclear waste, and industrial processes such as drying. The diffusion of water vapor in a packed bed containing residual liquid is examined experimentally. The objective is to quantify the effect of enhanced vapor diffusion resulting from evaporation/condensation in porous media subjected to a temperature gradient. Isothermal diffusion experiments in free-space were conducted to qualify the experimental apparatus and tech-

niques. For these experiments measured diffusion coefficients are within 3.6% of those reported in the literature for the temperature range from 25 C to 40 C. Isothermal experiments in packed beds of glass beads were used to determine the tortuosity coefficient resulting in tau = 0.78 +/-0.028, which is also consistent with previously reported results. Nonisothermal experiments in packed beds in which condensation occurs were conducted to examine enhanced vapor diffusion. The interpretation of the results for these experiments is complicated by a gradual, but continuous, build-up of condensate in the packed beds during the course of the experiment. Results indicate diffusion coefficients which increase as a function of saturation resulting in enhancement of the vapor-phase transport by a factor of approximately four compared to a dry porous medium.
NTIS
Diffusion; Condensates; Evaporation; Porosity

19990028338 Department of Energy, Washington, DC USA
Turbulence transport with nonlocal interactions
Linn, R. R., Department of Energy, USA; Clark, T. T., Department of Energy, USA; Harlow, F. H., Department of Energy, USA; Turner, L., Department of Energy, USA; Mar. 31, 1998; 83p; In English, USA
Report No.(s): DE98-004340; LA-13401-MS; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This preliminary report describes a variety of issues in turbulence transport analysis with particular emphasis on closure procedures that are nonlocal in wave-number and/or physical space. Anomalous behavior of the transport equations for large scale parts of the turbulence spectrum are resolved by including the physical space nonlocal interactions. Direct and reverse cascade processes in wave-number space are given a much richer potential for realistic description by the nonlocal formulations. The discussion also describes issues, many still not resolved, regarding new classes of self-similar form functions.
NTIS
Turbulent Flow; Spectra

19990028362 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Connection Between the Lattice Boltzmann Equation and the Beam Scheme ***Final Report***
Xu, Kun, Institute for Computer Applications in Science and Engineering, USA; Luo, Li-Shi, Institute for Computer Applications in Science and Engineering, USA; February 1999; 10p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209001; NAS 1.26:209001; ICASE-99-10; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In this paper we analyze and compare the lattice Boltzmann equation with the beam scheme in details. We notice the similarity and differences between the lattice Boltzmann equation and the beam scheme. We show that the accuracy of the lattice Boltzmann equation is indeed second order in space. We discuss the advantages and limitations of lattice Boltzmann equation and the beam scheme. Based on our analysis, we propose an improved multi-dimensional beam scheme.
Author
Boltzmann Transport Equation; Navier-Stokes Equation; Compressible Flow; Incompressible Flow; Computational Fluid Dynamics; Hydrodynamic Equations; Euler Equations of Motion; Finite Difference Theory; Finite Volume Method

19990028363 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA
Development of a Three-Dimensional PSE Code for Compressible Flows: Stability of Three-Dimensional Compressible Boundary Layers ***Final Report, Period ending 31 Dec. 1998***
Balakumar, P., Old Dominion Univ., USA; Jeyasingham, Samarasingham, Old Dominion Univ., USA; February 1999; 195p; In English
Contract(s)/Grant(s): NAG1-2054
Report No.(s): ODURF-182431; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

A program is developed to investigate the linear stability of three-dimensional compressible boundary layer flows over bodies of revolutions. The problem is formulated as a two dimensional (2D) eigenvalue problem incorporating the meanflow variations in the normal and azimuthal directions. Normal mode solutions are sought in the whole plane rather than in a line normal to the wall as is done in the classical one dimensional (1D) stability theory. The stability characteristics of a supersonic boundary layer over a sharp cone with 50 half-angle at 2 degrees angle of attack is investigated. The 1D eigenvalue computations showed that the most amplified disturbances occur around x(sub 2) = 90 degrees and the azimuthal mode number for the most amplified disturbances range between m = -30 to -40. The frequencies of the most amplified waves are smaller in the middle region where the crossflow dominates the instability than the most amplified frequencies near the windward and leeward planes. The 2D eigenvalue computations showed that due to the variations in the azimuthal direction, the eigenmodes are clustered into isolated confined

regions. For some eigenvalues, the eigenfunctions are clustered in two regions. Due to the nonparallel effect in the azimuthal direction, the eigenmodes are clustered into isolated confined regions. For some eigenvalues, the eigenfunctions are clustered in two regions. Due to the nonparallel effect in the azimuthal direction, the most amplified disturbances are shifted to 120 degrees compared to 90 degrees for the parallel theory. It is also observed that the nonparallel amplification rates are smaller than that is obtained from the parallel theory.
Author
Amplification; Azimuth; Eigenvalues; Slender Cones; Supersonic Boundary Layers; Turbulent Boundary Layer; Three Dimensional Flow; Three Dimensional Boundary Layer; Computational Fluid Dynamics; Navier-Stokes Equation; Reynolds Averaging; Runge-Kutta Method; Viscous Flow; Compressible Fluids

19990028505 NASA Goddard Space Flight Center, Greenbelt, MD USA
Design and Testing of a Cryogenic Capillary Pumped Loop Flight Experiment
Bugby, David C., Swales Aerospace, USA; Kroliczek, Edward J., Swales Aerospace, USA; Ku, Jentung, NASA Goddard Space Flight Center, USA; Swanson, Ted, NASA Goddard Space Flight Center, USA; Tomlinson, B. J., Air Force Research Lab., USA; Davis, Thomas M., Air Force Research Lab., USA; Baumann, Jane, Cullimore and Ring Technologies, Inc., USA; Cullimore, Brent, Cullimore and Ring Technologies, Inc., USA; 1998; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper details the flight configuration and pre-flight performance test results of the fifth generation cryogenic capillary pumped loop (CCPL-5). This device will fly on STS-95 in October 1998 as part of the CRYOTSU Flight Experiment. This flight represents the first in-space demonstration of a CCPL; a miniaturized two-phase fluid circulator for thermally linking cryogenic components. CCPL-5 utilizes N2 as the working fluid and has a practical operating range of 75-110 K. Test results indicate that CCPL-5, which weighs about 200 grams, can transport over 10 W of cooling a distance of 0.25 m (or more) with less than a 5 K temperature drop.
Author
Cryogenic Cooling; Flight Characteristics; Performance Tests; Cryogenics

19990028529 Department of Energy, Washington, DC USA
Development and implementation of sensitivity coefficient equations for heat conduction problems
Blackwell, B. F., Department of Energy, USA; Cochran, R. J., Department of Energy, USA; Dowding, K. J., Department of Energy, USA; Dec. 15, 1997; 30p; In English; Thermophysics and heat transfer, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004233; SAND-98-0060C; CONF-980610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Three different methods are discussed for computing the sensitivity of the temperature field to changes in material properties and initial-boundary condition parameters for heat conduction problems. The most general method is to derive sensitivity equations by differentiating the energy equation with respect to the parameter of interest and numerically solving the resulting sensitivity equations. An example problem in which there are twelve parameters of interest is presented and the resulting sensitivity equations are derived. Numerical results are presented for thermal conductivity and volumetric heat capacity sensitivity coefficients for heat conduction in a 2-D orthotropic body. The numerical results are compared with the analytical solution to demonstrate that the numerical method is second order accurate as the mesh is refined spatially.
NTIS
Sensitivity; Coefficients; Thermal Conductivity

19990028531 Department of Energy, Washington, DC USA
Irrecoverable pressure loss coefficients for a short radius of curvature piping elbow at high Reynolds numbers
Coffield, R. D., Department of Energy, USA; Hammond, R. B., Department of Energy, USA; Koczko, J. P., Department of Energy, USA; McKeown, P. T., Department of Energy, USA; Zirpoli, P. J., Department of Energy, USA; Jun. 30, 1998; 24p; In English, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004231; WAPD-T-3190; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Pressure drops in a piping elbow are experimentally determined for high Reynolds number flows. The testing described has been performed in order to reduce uncertainties in the currently used design values for predicting irrecoverable pressure losses. The earlier high Reynolds number correlations had been based on extrapolations over several orders of magnitude in Reynolds

number from where the original database existed. The test data shows about a factor of two lower elbow pressure loss coefficient 40 x 10(exp 6) Reynolds number than those current correlations.
NTIS
Pressure Ratio; Losses; Radii; Curvature; High Reynolds Number; Pipes (Tubes)

19990028560 Alabama Univ., Propulsion Research Center, Huntsville, AL USA
Mixing of Supersonic Streams
Hawk, Clark W., Alabama Univ., USA; Landrum, D. Brian, Alabama Univ., USA; Spetman, David, Alabama Univ., USA; Parkinson, Douglas, Alabama Univ., USA; JANNAF Airbreathing Propulsion Subcommittee Meeting; October 1997; Volume 1, pp. 1-9; In English; See also 19990028559
Contract(s)/Grant(s): NCC8-123; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The Strutjet approach to Rocket Based Combined Cycle (RBCC) propulsion depends upon fuel-rich flows from the rocket nozzles and turbine exhaust products mixing with the ingested air for successful operation in the ramjet and scram jet modes. A model of the Strutjet device has been built and is undergoing test to investigate the mixing of the streams as a function of distance from the Strutjet exit plane. The modeling basis was centered on using convective Mach Number as the similarity parameter to establish correlation between subscale, cold flow tests and full scale, hot firing modes. This parameter has been successfully used to correlate supersonic shear layer growth rates. The experiment design includes hot (600 R) air as the rocket exhaust simulant and hot (760 R) carbon dioxide as the turbine exhaust gas simulant. The combination of gases and their elevated temperatures was required to achieve a convective Mach Number which matched the full scale item design conditions. The carbon dioxide is seeded with Acetone to permit tracing of the mixing processes through Laser Induced Fluorescence (LIF) techniques. The model incorporates unique nozzle shapes: the primary rockets transition from a round throat to a square exit and the gas generator has a rectangular throat and rectangular exit. Cold flow testing verified the behavior of the GG nozzle was typical of more conventional designs. The experimental facility and planned experimentation are discussed.
Author
Propulsion; Rocket Nozzles; Turbines; Reusable Launch Vehicles; Turbine Exhaust Nozzles; Experiment Design; Spacecraft Models; Dynamic Models; Supersonic Jet Flow; Rocket Engine Design; Combined Cycle Power Generation

19990028833 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Diffeomorphism with Some Sobolev Metric, Geodesic Flow and Integrable Systems
Guha, P., Institut des Hautes Etudes Scientifiques, France; Sep. 1998; 18p; In English
Report No.(s): PB99--122426; IHES/M/98/69; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, the authors first derive the Camassa-Holm equation as the geodesic flow of the H(sup 1) metric on the Bott-Virasoro group. Then the authors are able to establish an interesting connection between the projective vector field, a vector field leaves fixed a given projective connection, and the C. Neumann system using the idea of Knorrer and Moser. In fact, the authors show that the stabilizer of a point in Omega G(star) of the coadjoint representation of the Virasoro algebra, having some Sobolev norm, consists of projective vector fields and some quadratic function of a projective vector field satisfies C. Neumann system.
NTIS
Algebra; Sobolev Space; Geodesy

19990031933 Department of Defense, Washington, DC USA
Progress in smooth particle hydrodynamics
Wingate, C. A., Department of Defense, USA; Dilts, G. A., Department of Defense, USA; Mandell, D. A., Department of Defense, USA; Crotzer, L. A., Department of Defense, USA; Knapp, C. E., Department of Defense, USA; Dec. 31, 1998; 18p; In English; Shock Physics, USA; Sponsored by Department of Energy, USA
Report No.(s): DE98-003590; LA-UR-98-300; CONF-9711159; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Smooth Particle Hydrodynamics (SPH) is a meshless, Lagrangian numerical method for hydrodynamics calculations where calculational elements are fuzzy particles which move according to the hydrodynamic equations of motion. Each particle carries local values of density, temperature, pressure and other hydrodynamic parameters. A major advantage of SPH is that it is meshless, thus large deformation calculations can be easily done with no connectivity complications. Interface positions are known and there are no problems with advecting quantities through a mesh that typical Eulerian codes have. These underlying SPH features make fracture physics easy and natural and in fact, much of the applications work revolves around simulating fracture. Debris particles from impacts can be easily transported across large voids with SPH. While SPH has considerable promise, there are some prob-

lems inherent in the technique that have so far limited its usefulness. The most serious problem is the well known instability in tension leading to particle clumping and numerical fracture. Another problem is that the SPH interpolation is only correct when particles are uniformly spaced a half particle apart leading to incorrect strain rates, accelerations and other quantities for general particle distributions. SPH calculations are also sensitive to particle locations. The standard artificial viscosity treatment in SPH leads to spurious viscosity in shear flows. This paper will demonstrate solutions for these problems that they and others have been developing. The most promising is to replace the SPH interpolant with the moving least squares (MLS) interpolant invented by Lancaster and Salkauskas in 1981. SPH and MLS are closely related with MLS being essentially SPH with corrected particle volumes. When formulated correctly, JLS is conservative, stable in both compression and tension, does not have the SPH boundary problems and is not sensitive to particle placement. The other approach to solving SPH problems, pioneered by Randles and Libersky, is to use a different SPH equation and to renormalize the kernel gradient sums. Finally the authors present results using the SPH statistical fracture model (SPHSFM). It has been applied to a series of ball on plate impacts performed by Grady and Kipp. A description of the model and comparison with the experiments will be given.
NTIS
Particles; Hydrodynamics; Lagrangian Function

19990031935 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Gas-phase diffusion in porous media: Comparison of models
Webb, S. W., Department of Energy, USA; Dec. 31, 1998; 8p; In English; TOUGH '98 Workshop, 1998, USA
Report No.(s): DE98-003553; SAND-98-1417C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two models are commonly used to analyze gas-phase diffusion in porous media in the presence of advection, the Advective-Dispersive Model (ADM) and the Dusty-gas Model (DGM). The ADM, which is used in TOUGH2, is based on a simple linear addition of advection calculated by Darcy's law and ordinary diffusion using Fick's law with a porosity-tortuosity-gas saturation multiplier to account for the porous medium. Another approach for gas-phase transport in porous media is the Dusty-Gas Model. This model applies the kinetic theory of gases to the gaseous components and the porous media (or dust) to combine transport due to diffusion and advection that includes porous medium effects. The two approaches are compared in this paper.
NTIS
Gas Dynamics; Diffusion; Porosity; Vapor Phases; Mathematical Models; Comparison

19990032055 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Boundary element method applied to a gas-fired pin-fin-enhanced heat pipe
Andraka, C. E., Department of Energy, USA; Knorovsky, G. A., Department of Energy, USA; Drewien, C. A., Department of Energy, USA; Feb. 28, 1998; 81p; In English
Report No.(s): DE98-004181; SAND-98-0306; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The thermal conduction of a portion of an enhanced surface heat exchanger for a gas fired heat pipe solar receiver was modeled using the boundary element and finite element methods (BEM and FEM) to determine the effect of weld fillet size on performance of a stud welded pin fin. A process that could be utilized by others for designing the surface mesh on an object of interest, performing a conversion from the mesh into the input format utilized by the BEM code, obtaining output on the surface of the object, and displaying visual results was developed. It was determined that the weld fillet on the pin fin significantly enhanced the heat performance, improving the operating margin of the heat exchanger. The performance of the BEM program on the pin fin was measured (as computational time) and used as a performance comparison with the FEM model. Given similar surface element densities, the BEM method took longer to get a solution than the FEM method. The FEM method creates a sparse matrix that scales in storage and computation as the number of nodes (N), whereas the BEM method scales as N2 in storage and N3 in computation.
NTIS
Boundary Element Method; Gas Pipes; Pins; Heat Pipes

19990032156 Helsinki Univ. of Technology, Lab. of Materials Science and Metallury, Espoo, Finland
Study of Process Parameters on Two Phase Flow Agitated by Top Blowing Lance Injection into a Bath
Xia, J., Helsinki Univ. of Technology, Finland; Ahokainen, T., Helsinki Univ. of Technology, Finland; Holappa, L., Helsinki Univ. of Technology, Finland; 1998; 36p; In English
Report No.(s): PB99-121709; TKK-MK-45; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Numerical investigation has been carried out for two phase flow in a bath agitated by top blowing lance injection. Eulerian two phase flow model is used. Lance immersion depth, injection gas flow rate, nozzle diameter, and bubble size have been system-

atically changed to examine their influence on the flow characteristics in the bath. It is found that there are three typical flow patterns: one-vortex, two-vortex, and three-vortex type, with changing the injection gas flow rate and/or the nozzle diameter at moderate lance immersion depth. Predicted velocities are in good agreement with Iguchi's experimental data and the main findings are also consistent with the measurements and observations of Chatterjee and Hsiao and Lehner.
NTIS
Two Phase Flow; Fluid Injection; Fuel Injection; Flow Distribution; Flow Velocity; Nozzle Flow; Upper Surface Blowing

19990032168 NASA Lewis Research Center, Cleveland, OH USA
Hydrodynamic Dryout in Two-Phase Flows: Observations of Low Bond Number Systems
Weislogel, Mark M., NASA Lewis Research Center, USA; McQuillen, John B., NASA Lewis Research Center, USA; 1998; In English; 3rd; Space Technology and Information Forum: Commercial Development of Space, 25-29 Jan. 1998, Albuquerque, NM, USA
Contract(s)/Grant(s): RTOP 963-25-OH; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Dryout occurs readily in certain slug and annular two-phase flows for systems that exhibit partial wetting. The mechanism for the ultimate rupture of the film is attributed to van der Waals forces, but the pace towards rupture is quickened by the surface tension instability (Rayleigh-type) of the annular film left by the advancing slug and by the many perturbations of the free surface present in the Re(sub g) approximately 0(10(exp 3)), Re(sub l) approximately 0(10(exp 4)), and Ca approximately 0(10(exp -1) flows. Results from low-gravity experiments using three different test fluids are presented and discussed. For the range of tests conducted, the effect of increasing viscosity is shown to eliminate the film rupture while the decrease of surface tension via a surfactant additive is shown to dramatically enhance it. Laboratory measurements using capillary tubes are presented which reveal the sensitivity of the dryout phenomena to particulate and surfactant contamination. Rom such observations, dryout due to the hydrodynamic-van der Waals instability can be expected in a certain range of flow parameters in the absence of heat transfer. The addition of heat transfer may only exacerbate the problem by producing thermal transport lines replete with ”hot spots.” A caution to this effect is issued to future space systems designers concerning the use of partially wetting working fluids.
Author
Two Phase Flow; Aerospace Systems; Annular Flow; Interfacial Tension; Additives; Flow Characteristics; Particulates

19990032177 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Multiphase integral reacting flow computer code (ICOMFLO): User's guide
Chang, S. L., Department of Energy, USA; Lottes, S. A., Department of Energy, USA; Petrick, M., Department of Energy, USA; Nov. 30, 1997; 106p; In English
Report No.(s): DE98-005157; ANL/MHD-97/01; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A copyrighted computational fluid dynamics computer code, ICOMFLO, has been developed for the simulation of multiphase reacting flows. The code solves conservation equations for gaseous species and droplets (or solid particles) of various sizes. General conservation laws, expressed by elliptic type partial differential equations, are used in conjunction with rate equations governing the mass, momentum, enthalpy, species, turbulent kinetic energy, and turbulent dissipation. Associated phenomenological submodels of the code include integral combustion, two parameter turbulence, particle evaporation, and interfacial submodels. A newly developed integral combustion submodel replacing an Arrhenius type differential reaction submodel has been implemented to improve numerical convergence and enhance numerical stability. A two parameter turbulence submodel is modified for both gas and solid phases. An evaporation submodel treats not only droplet evaporation but size dispersion. Interfacial submodels use correlations to model interfacial momentum and energy transfer. The ICOMFLO code solves the governing equations in three steps. First, a staggered grid system is constructed in the flow domain. The staggered grid system defines gas velocity components on the surfaces of a control volume, while the other flow properties are defined at the volume center. A blocked cell technique is used to handle complex geometry. Then, the partial differential equations are integrated over each control volume and transformed into discrete difference equations. Finally, the difference equations are solved iteratively by using a modified SIMPLER algorithm. The results of the solution include gas flow properties (pressure, temperature, density, species concentration, velocity, and turbulence parameters) and particle flow properties (number density, temperature, velocity, and void fraction). The code has been used in many engineering applications, such as coal-fired combustors, air-breathing propulsion engines, and internal combustion engines.
NTIS
Multiphase Flow; Computer Programs; User Manuals (Computer Programs)

19990032258 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Computational analysis of natural convection in a vertical channel with a modified power law non-Newtonian fluid
Lee, S. R., Department of Energy, USA; Irvine, T. F., Department of Energy, USA; Greene, G. A., Department of Energy, USA; Apr. 30, 1998; 9p; In English; 11th; Heat transfer, USA
Report No.(s): DE98-004981; BNL-65444; CONF-980806; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An implicit finite difference method was applied to analyze laminar natural convection in a vertical channel with a modified power law fluid. This fluid model was chosen because it describes the viscous properties of a pseudoplastic fluid over the entire shear rate range likely to be found in natural convection flows since it covers the shear rate range from Newtonian through transition to simple power law behavior. In addition, a dimensionless similarity parameter is identified which specifies in which of the three regions a particular system is operating. The results for the average channel velocity and average Nusselt number in the asymptotic Newtonian and power law regions are compared with numerical data in the literature. Also, graphical results are presented for the velocity and temperature fields and entrance lengths. The results of average channel velocity and Nusselt number are given in the three regions including developing and fully developed flows. As an example, a pseudoplastic fluid (carboxymethyl cellulose) was chosen to compare the different results of average channel velocity and Nusselt number between a modified power law fluid and the conventional power law model. The results show, depending upon the operating conditions, that if the correct model is not used, gross errors can result.
NTIS
Free Convection; Nonnewtonian Fluids; Laminar Flow

19990032286 California Univ., Dept. of Mechanical, Aerospace and Nuclear Engineering, Los Angeles, CA USA
Friction Factor for Flow in Rectangular Ducts with One Side Rib-Roughened
Youn, B., California Univ., USA; Yuen, C., California Univ., USA; Mills, A. F., California Univ., USA; Journal of Fluids Engineering; September 1994; Volume 116, pp. 488-493; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Numerical simulations of incompressible turbulent flow through rectangular ducts with one side rib-roughened were performed to determine pressure drop. The ”PHOENICS ” software package was used for the computations, which required provision of a wall function for transverse rib-roughened surfaces. The present study was conducted in the range of 10(exp 5) less than or equal to Reynolds number less than or equal to 10(exp 7), 0.01 less than or equal to rib height to hydraulic diameter ratio less than or equal to 0.04, 10 less than or equal to pitch to rib height ratio less than or equal to 40. Using the numerical results, friction factor charts for various aspect ratios were generated. The numerical results agreed well with experimental data that was obtained for 10(exp 5) less than Reynolds less than 2 x 10(exp 5). In addition, a scheme for predicting friction factor using existing correlations for smooth and rough walls was developed.
Author
Friction Factor; Turbulent Flow; Ribs (Supports); Reynolds Number; Incompressible Flow; Ducts

19990032563 AYT Corp., Brook Park, OH USA
Heat Transfer on a Film-Cooled Blade: Effect of Hole Physics
Garg, Vijay K., AYT Corp., USA; Rigby, David L., DYNACS Engineering Co., Inc., USA; International Journal of Heat and Fluid Flow; 1999; ISSN 0142-727X; Volume 20, pp. 10-25; In English
Report No.(s): ASME Paper 98-GT-404; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A multiblock, three-dimensional Navier Stokes code has been used to study the within-hole and near-hole physics in relation to heat transfer on a film-cooled blade. The flow domain consists of the coolant flow through the plenum and hole-pipes for the three staggered rows of shower-head holes on the VKI rotor, and the main flow over the blade. A multiblock grid is generated that is nearly orthogonal to the various surfaces. It may be noted that for the VKI rotor the shower-head holes are inclined at 30 deg to the spanwise direction, and are normal to the streamwise direction on the blade. Wilcox’s k-omega turbulence model is used. The present study provides a much better comparison for the span-averaged heat transfer coefficient on the blade surface with the experimental data than an earlier analysis wherein coolant velocity and temperature distributions were specified at the hole exits rather than extending the computational domain into the hole-pipe and plenum. Details of the distributions of coolant velocity, temperature, k and omega at the hole exits are also presented.
Author
Heat Transfer; Turbulence Models; Holes (Mechanics); Heat Transfer Coefficients; Hole Distribution (Mechanics)

19990032565 NASA Lewis Research Center, Cleveland, OH USA

Flow Coupling Effects in Jet-in-Crossflow Flowfields

Holdeman, J. D., NASA Lewis Research Center, USA; Bain, D. B., CFD Research Corp., USA; Smith, C. E., CFD Research Corp., USA; Liscinsky, D. S., United Technologies Corp., USA; Journal of Propulsion and Power; Jan. 1999; Volume 15, No. 1, pp. 10-16; In English; 32nd; Joint Propulsion, 1-3 Jul. 1996, Lake Buena Vista, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS3-25967; NAS3-25954

Report No.(s): AIAA Paper 96-2762; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The combustor designer is typically required to design liner orifices that effectively mix airjets with crossflow effluent. Computational fluid dynamics (CFD) combustor analysis is typically used in the design process; however, the jets are usually assumed to enter the combustor with a uniform velocity and turbulence profile. The jet-mainstream flow coupling is usually neglected because of the computational expense. This study was performed to understand the effect of jet and mainstream flow coupling, and to investigate jet boundary conditions that are commonly used in combustor internal calculations. A case representative of a plenum-fed quick-mix section of a rich burn/quick mix/lean burn combustor, i.e., a jet to mainstream mass-flow ratio of about 3 and a jet to mainstream momentum-flux ratio of about 30, was investigated. This case showed that the jet velocity entering the combustor was very nonuniform, with a low normal velocity at the leading edge of the orifice and a high normal velocity at the trailing edge of the orifice. Three different combustor-only cases were analyzed, each with a uniform inlet jet profile. None of the cases matched the plenum-fed calculations. to assess liner thickness effects, a thin-walled case was also analyzed. The CFD analysis showed the thin-walled jets had more penetration than the thick-walled jets.

Author

Combustion Chambers; Cross Flow; Flow Distribution; Computational Fluid Dynamics; Turbulence; Velocity Distribution; Jet Flow; Air Jets

19990032566 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

The Dissipation Range in Rotating Turbulence ***Final Report***

Rubinstein, Robert, Institute for Computer Applications in Science and Engineering, USA; Zhou, Ye, Institute for Computer Applications in Science and Engineering, USA; February 1999; 10p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-1999-208997; NAS 1.26:208997; ICASE-99-8; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The dissipation range energy balance of the direct interaction approximation is applied to rotating turbulence when rotation effects persist well into the dissipation range. Assuming that RoRe (exp 1/2) is much less than 1 and that three-wave interactions are dominant, the dissipation range is found to be concentrated in the wavevector plane perpendicular to the rotation axis. This conclusion is consistent with previous analyses of inertial range energy transfer in rotating turbulence, which predict the accumulation of energy in those scales.

Author

Energy Transfer; Turbulence; Wave Interaction; Vortices; Inertia; Dissipation

19990032567 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

Double Resonances and Spectral Scaling in the Weak Turbulence Theory of Rotating and Stratified Turbulence ***Final Report***

Rubinstein, Robert, Institute for Computer Applications in Science and Engineering, USA; February 1999; 18p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-1999-208996; NAS 1.26:208996; ICASE-99-7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In rotating turbulence, stably stratified turbulence, and in rotating stratified turbulence, heuristic arguments concerning the turbulent time scale suggest that the inertial range energy spectrum scales as k(exp -2). From the viewpoint of weak turbulence theory, there are three possibilities which might invalidate these arguments: four-wave interactions could dominate three-wave interactions leading to a modified inertial range energy balance, double resonances could alter the time scale, and the energy flux integral might not converge. It is shown that although double resonances exist in all of these problems, they do not influence overall energy transfer. However, the resonance conditions cause the flux integral for rotating turbulence to diverge logarithmically when

evaluated for a k(exp -2) energy spectrum; therefore, this spectrum requires logarithmic corrections. Finally, the role of four-wave interactions is briefly discussed.
Author
Turbulence; Rotation; Energy Spectra; Heuristic Methods; Energy Transfer

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INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Aircraft Instrumentation, and 19 Space Instrumentation.

19990028337 Department of Energy, Washington, DC USA
Comparisons between digital gamma-ray spectrometer (DSPec) and standard nuclear instrumentation methods (NIM) systems
Vo, D. T., Department of Energy, USA; Russo, P. A., Department of Energy, USA; Sampson, T. E., Department of Energy, USA; Mar. 31, 1998; 15p; In English, USA
Report No.(s): DE98-004347; LA-13393-MS; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Safeguards isotopic measurements require the best spectrometer systems with excellent resolution, stability and throughput. Up until about a year ago, gamma ray spectroscopy has always been done using the analog amplifier, which processes the pulses from the preamplifier to remove the noise, reject the pile up signals, and shape the signals into some desirable form before sending them to the analog to digital converter (ADC) to be digitized. In late 1996, EG and G Ortec introduced a digital gamma ray spectrometer (DSPec) which uses digital technology to analyze the preamplifiers' pulses from all types of germanium and silicon detectors. Considering its performance, digital based spectroscopy may become the way of future gamma ray spectroscopy.
NTIS
Gamma Ray Spectrometers; Digital Systems; Comparison

19990028446 Range Commanders Council, White Sands Missile Range, NM USA
IRIG Optical Tracking Systems Calibration Catalog
Feb. 1999; 55p; In English
Report No.(s): AD-A360596; RCC-755-99; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This document will serve as the IRIG reference for optical tracking systems calibrations; it may be reproduced as necessary for appropriate Do agencies and their contractors.
DTIC
Optical Tracking; Calibrating

19990028447 Range Commanders Council, White Sands Missile Range, NM USA
The Radar Roadmap
Sep. 1998; 43p; In English
Report No.(s): AD-A360595; ETMC-260-98; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Instrumentation radar has played a very significant role in testing and training for more than 50 years. Along with optics, it has been a major supplier of time space position information (TSPI). With the advent of the Global Positioning System (GPS), the need for instrumentation radar for TSPI has been called into question. Is radar still needed? Or can it be replaced by GPS? The members of the ETMO argue that radar is still needed. A study of requirements at over 25 test and training ranges has shown that radar, far from being passe', is needed more than ever. Radar is needed for TSPI on objects that cannot be instrumented for GPS. It is also needed for a variety of specialized measurements, including radar cross section (i.e., stealthiness), characterization of debris, and assessment of damage at intercept. This paper discusses the future needs of instrumentation radar and presents the radar roadmap (i.e., the plan) for satisfying those needs at the test, training, and operational ranges for 10, 20, and even 30 years into the future.
DTIC
Radar; Real Time Operation; Phased Arrays; High Resolution

19990028463 Department of Energy, Washington, DC USA

Results of performance testing the Russian RPV temperature measurement probe used for annealing

Nakos, J. T., Department of Energy, USA; Selsky, S., Department of Energy, USA; Mar. 31, 1998; 29p; In English; Reactor pressure vessel thermal annealing demonstration, USA; Sponsored by Electric Power Research Inst., USA

Report No.(s): DE98-004210; SAND-98-0781C; CONF-980353; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper provides information on three (3) topics related to temperature measurements in an annealing procedure: (1) results of a series of experiments performed by CNIITMASH of the Russian consortium MOHT on their reactor pressure vessel (RPV) temperature measurement probe, (2) a discussion regarding uncertainties and errors in RPV temperature measurements, and (3) predictions from a thermal model of a spherical RPV temperature measurement probe. MOHT teamed with MPR Associates and was to perform the Annealing Demonstration Project (ADP) on behalf of the US Department of Energy, ESEERCo, EPRI, CRIEPI, Framatome, and Consumers Power Co. at the Midland plant. Experimental results show that the CNIITMASH probe errors are a maximum of about 27 C (49 F) during a 15 C/hr (27 F/hr) heat-up but only about 3 C (5.4 F) (0.6%) during the hold portion at 470 C (878 F). These errors are much smaller than those obtained from a similar series of experiments performed by Sandia National Laboratories (Sandia). The discussion about uncertainties and errors shows that results presented as a temperature difference provides a measure of the probe error. Qualitative agreement is shown between the model predictions, the experimental results of the CNIITMASH probe and the experimental results of a series of similar experiments performed by Sandia.

NTIS

Performance Tests; Remotely Piloted Vehicles; Temperature Measurement; Annealing

19990028506 NASA Lewis Research Center, Cleveland, OH USA

Flight Tests on a Fiber Optic Temperature Sensor

Tuma, Margaret L., NASA Lewis Research Center, USA; Sawatari, Takeo, Sentec Corp., USA; Lin, Yuping, Sentec Corp., USA; Elam, Kristie A., Gilcrest Electric, USA; 1998; 7p; In English; 17th; Digital Avionics Systems Conference (DASC), 31 Oct. - 6 Nov. 1998, Bellevue, WA, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Contract(s)/Grant(s): RTOP 519-30-53; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

For aircraft engine control, one key parameter to detect on an airplane is the exhaust gas temperature (EGT). Presently, thermocouples are used to perform this measurement. These electrical sensors perform adequately; however, fully utilizing the benefits of optical sensors requires replacing electrical architectures with optical architectures. Part of this requires replacing electrical sensors with optical sensors, such as the EGT sensor chosen for these tests. The objective of the development and testing of this prototype sensor system was to determine the feasibility of operating an optical sensor in a hostile aircraft environment. The fiber optic sensor system was developed to measure temperatures from 20C to 600C in an aircraft environment and was utilized to monitor the EGT of an OV-10D aircraft engine. The sensor has successfully flown over 50 hours and proven to be immune to surface deterioration of the optical element (located inside the sensor head) and able to withstand and operate in normal and sustained severe flight conditions where forces on the airplane exceeded 4 g's. Potential commercial uses for this sensor include monitoring temperature for aeropropulsion system control, military vehicle and naval engine control, conventional and nuclear power plant monitoring and industrial plan monitoring where EMI issues are critical.

Author

Aircraft Engines; Exhaust Gases; Fiber Optics; Gas Temperature; Optical Measuring Instruments; Temperature Sensors; Fabry-Perot Interferometers

19990028513 Southwest Research Inst., Instrumentation and Space Research Div., San Antonio, TX USA

Particle Detectors and Data Analysis for Cusp Transient Features Campaign

Sharber, James R., Southwest Research Inst., USA; Dec. 31, 1998; 24p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-5084; SwRI Proj. 15-8087; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On December 3, 1997, a rocket payload (36.152) was launched from Ny Alesund into the dark cusp at 0906:00 U (1206:00 LT) during an interval of southward B(sub Z), and positive B(sub y). Launch occurred during a time interval of northeastward moving auroral forms observed between 0845 and 0945 UT by ground-based meridian scanning photometers. Ground photometric measurements during the flight show that the payload passed over the poleward portion of the most intense 6300 A emissions of the dayside cusp/cleft region. Electrons of energy up to a few hundred eV were detected immediately upon instrument turn-on at an altitude of 205 km and throughout the flight until the payload reached an altitude of approximately 197 km on the downleg. Electron spectra were either quasithermal with peak energies approximately 100 eV or showed evidence of acceleration along the magnetic field line by potentials of 100-200 V. Precipitating ions were observed throughout much of the flight. Their spectra were broadly peaked in energy with the peak energy decreasing from approximately 500 eV to approximately 250 eV as the pay-

load flew approximately westward over the dayside precipitationregion. Structure(spatial or temporal intensity variation) was observed between T + 180 s and T + approximately 400 s. At the rocket altitudes(less than 450km) the ions were observed to be precipitating. During the flight, the DMSPF-13 satellite passed through the all-sky imager field-of-view just poleward of the brightest dayside emissions enabling the identification of plasma sheet and boundary layer regions along the orbit. We thus conclude that particle fluxes detected by the rocket flight were either cusp plasma or boundary layer/mantle plasmajust poleward of the dayside cusp/cleft. Further investigation of the particle characteristics and their relationship to ionospheric convection patterns is continuing.
Author
Launching; Payloads; Energy Spectra; Electron Energy; Boundary Layer Plasmas; Radiation Counters

19990028523 Department of Energy, Office of Energy Research, Washington, DC USA
Monolithic circuits for barium fluoride detectors used in nuclear physics experiments ***Final Report***
Varner, R. L., Department of Energy, USA; Blankenship, J. L., Department of Energy, USA; Beene, J. R., Department of Energy, USA; Todd, R. A., Department of Energy, USA; Feb. 28, 1998; 57p; In English
Report No.(s): DE98-052484; ORNL/M-6390; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Custom monolithic electronic circuits have been developed recently for large detector applications in high energy physics where subsystems require tens of thousands of channels of signal processing and data acquisition. In the design and construction of these enormous detectors, it has been found that monolithic circuits offer significant advantages over discrete implementations through increased performance, flexible packaging, lower power and reduced cost per channel. Much of the integrated circuit design for the high energy physics community is directly applicable to intermediate energy heavy-ion and electron physics. This STTR project conducted in collaboration with researchers at the Holifield Radioactive Ion Beam Facility (HRIBF) at Oak Ridge National Laboratory, sought to develop a new integrated circuit chip set for barium fluoride (BaF2) detector arrays based upon existing CMOS monolithic circuit designs created for the high energy physics experiments. The work under the STTR Phase 1 demonstrated through the design, simulation, and testing of several prototype chips the feasibility of using custom CMOS integrated circuits for processing signals from BaF2 detectors. Function blocks including charge-sensitive amplifiers, comparators, one shots, time-to- amplitude converters, analog memory circuits and buffer amplifiers were implemented during Phase 1 effort. Experimental results from bench testing and laboratory testing with sources were documented.
NTIS
Integrated Circuits; Barium Fluorides; Design Analysis; Fabrication; Signal Processing

19990028631 Department of Energy, Office of Energy Research, Washington, DC USA
Wide-range phosphor thermometry technique
Allison, S. W., Department of Energy, USA; Beshears, D. L., Department of Energy, USA; Cates, M. R., Department of Energy, USA; Gillies, G. T., Department of Energy, USA; Mar. 31, 1998; 12p; In English; 44th, USA
Report No.(s): DE98-005049; ORNL/CP-97624; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fluorescing materials exhibit a temperature dependence, which may be exploited for thermometry purposes. Solid state materials such as phosphors, glasses and crystals are examples of such and have been used in commercial instruments and various one-of-a- kind research and development applications. This area has been the subject of previous ISA papers. It is generally the case that fluorescence decay time or lifetime is the parameter that is measured in order to determine temperature for applications that do not require imaging. There are several good reasons for this. The decay time is a very sensitive function of temperature. Time- and rate-dependent methods are independent of amplitude fluctuations and are therefore not as susceptible to optical noise. In some applications, however, other aspects of the temperature-dependent fluorescence can also be useful. What follows is a description that concerns intensity-based methods and the types of applications to which they apply. The emphasis of the present work is the advantage for situations demanding a wide range and rapidly varying temperatures.
NTIS
Phosphors; Temperature Measurement; Fluorescence; Procedures; Imaging Techniques

19990028642 Department of Energy, Office of Energy Research, Washington, DC USA
Atom-probe field ion microscope: Applications in surface science
Kellogg, G. L., Department of Energy, USA; Feb. 28, 1998; 4p; In English; Microscopy and Microanalysis 1998, USA
Report No.(s): DE98-005037; SAND-98-0520C; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The ability to locate an individual atom on a surface, remove it in a controlled fashion, and determine its chemical identity makes the atom-probe field-ion microscope an extremely powerful tool for the analysis of solid surfaces. by itself, the field ion

microscope has contributed significantly to the understanding of surface atomic structure, single atom surface diffusion, and the detailed interactions that occur between atoms and defects on surfaces. When used in combination with the atom-probe mass spectrometer there have been several additional areas within the traditional definition of 'surface science' where the chemical identification capability of the atom probe has led to new insights. In this paper these applications are reviewed focusing on two specific areas: surface segregation in intermetallic alloys and chemical reactions on metal surfaces.
NTIS
Atomic Structure; Ion Microscopes; Surface Diffusion; Metal Surfaces

19990028800 Department of Energy, Washington, DC USA
AC phase measuring interferometer for measuring dn/dT of fused silica and calcium fluoride at 193 nm
Shagam, R. N., Department of Energy, USA; Dec. 31, 1998; 12p; In English; 43rd; Optical science, engineering, and instrumentation, USA
Report No.(s): DE98-005923; SAND-98-0007C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A novel method for the measurement of the change in index of refraction vs. temperature (dn/dT) of fused silica and calcium fluoride at the 193 nm wavelength has been developed in support of thermal modeling efforts for the development of 193 nm-based photolithographic exposure tools. The method, based upon grating lateral shear interferometry, uses a transmissive linear grating to divide a 193 nm laser beam into several beam paths by diffraction which propagate through separate identical material samples. One diffracted order passing through one sample overlaps the undiffracted beam from a second sample and forms interference fringes dependent upon the optical path difference between the two samples. Optical phase delay due to an index change from heating one of the samples causes the interference fringes to change sinusoidally with phase. The interferometer also makes use of Alternating Current (AC) phase measurement techniques through lateral translation of the grating. Results for several samples of fused silica and calcium fluoride are demonstrated.
NTIS
Alternating Current; Silica Glass; Calcium Fluorides; Phase Switching Interferometers

19990028810 Department of Energy, Office of Energy Research, Washington, DC USA
Low-cost hydrogen sensors: Technology maturation progress
Hoffheins, B. S., Department of Energy, USA; Rogers, J. E., Department of Energy, USA; Lauf, R. J., Department of Energy, USA; Egert, C. M., Department of Energy, USA; Haberman, D. P., Department of Energy, USA; Apr. 30, 1998; 19p; In English; Hydrogen program technical review, USA; Sponsored by Department of Energy, USA
Report No.(s): DE98-005668; ORNL/CP-98307; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The authors are developing a low-cost, solid-state hydrogen sensor to support the long-term goals of the Department of Energy (DOE) Hydrogen Program to encourage acceptance and commercialization of renewable energy-based technologies. This report describes the current efforts to optimize materials and sensor performance to reach the goals of low-cost fabrication and suitability for relevant application areas.
NTIS
Hydrogen; Energy Technology; Gas Detectors

19990032103 Cornell Univ., Ithaca, NY USA
KWIC: A Widefield Mid-Infrared Array Camera/Spectrometer for the KAO ***Final Report***
Stacey, Gordon J., Cornell Univ., USA; [1999]; 4p; In English
Contract(s)/Grant(s): NAG2-800; NAG2-1072
Report No.(s): OPS-23365; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The Kuiper Widefield Infrared Camera (KWIC) is an imaging spectrometer designed for use on the Kuiper Airborne Observator between 18 and 40 microns. The spectral resolution achieving devices are two fully tunable and scanning cryogenic Fabry-Perot interferometers that employ free standing metal mesh as the reflective surfaces. The detective device is a 128 x 128 pixel Si:Sb BIB array manufactured by Rockwell/Boeing for the SIRTF project. The plate scale for KWIC (one pixel subtends 2.73" x 2.73") was chosen so as to more than fully sample the KAO beam (approximately 9" at 31.5 microns), to enable effective image restoration techniques to be applied. Even so, KWIC has a rather large (5.8' x 5.8') field of view. KWIC has both high and low spectral resolution modes that are interchangeable in a few minutes time in flight on the KAO. The high resolution (R = lambda/(delta)lambda = 1000 to 6000) mode is suitable for detecting weak lines in the presence of strong continuum for Galactic

sources, and for resolving broad extragalactic lines. The low resolution (R approximately 30 to 100) mode is suitable for imaging in the thermal dust continuum.
Derived from text
Imaging Spectrometers; Infrared Radiation; Cameras; Spectral Resolution; Fabry-Perot Interferometers; Cryogenics

19990032170 NASA Ames Research Center, Moffett Field, CA USA
Simple Device for Monitoring Secondary Electron Emission of Materials in the Pulse Mode
Krainsky, Isay L., NASA Ames Research Center, USA; Lesny, Gary G., NASA Ames Research Center, USA; Review of Scientific Instruments; Apri. 1998; Volume 69, No. 4, pp. 1916-1917; In English
Contract(s)/Grant(s): RTOP 632-50-5D; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
A simple device for simultaneously measuring the secondary electron emission coefficient sigma, and the primary current in the pulse mode has been built. It allows convenient monitoring of these parameters for either conductive or insulating materials. Author
Electron Emission; Secondary Emission; Monitors

19990032240 Illinois Univ., Aviation Research Lab., Savoy, IL USA
Allocation of Attention with Head-Up Displays ***Final Report***
Wickens, C. D.; Ververs, P. M.; Nov. 1998; 19p; In English
Report No.(s): AD-A359344; DOT/FAA/AM-98/28; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Two experiments examined the effects of display location (head up vs. head down) and image intensity/clutter on flight path performance and mid-air target detection in a general aviation cruise flight environment. In Experiment 1, a low-fidelity simulation, both near-domain and far-domain Instrumentation were presented at the same optical distance. Detection of commanded flight changes and maintenance of desired flight path flight were generally better in the head-down condition, an advantage attributed to the superior image contrast ratios in that condition. In contrast, target detection was superior with the head-up display, reflecting an attentional tradeoff Experiment 2 was performed with pilots viewing far-domain imagery (and airborne targets) on an Evans and Sutherland display positioned near optical infinity, head-up display (HUD) imagery at the same optical distance, and head-down imagery at a near distance typical of the instrument panel. The degree of clutter was also varied and image contrast ratios were equated between head-up and head-down viewing conditions. Flight performance was equivalent between the HUD and head-down locations. However, detection of both near-domain events (commanded changes) and far-domain targets was better in the HUD condition, revealing the HUD benefit of reduced scanning. Adding extra information (clutter) to the HUD inhibited detection of both events in both head-up and head-down locations. However, this clutter cost was diminished for far-domain target detection if the added information was ”low-lighted.” Flight performance was superior in clear weather, when the true horizon was available for viewing. The data provided little evidence that attention was modulated in depth (near vs. far domains), but rather suggested that attention was modulated between tasks (flight control and detection).
DTIC
Head-Up Displays; Flight Characteristics; Flight Control

19990032426 Naval Research Lab., Chemical Dynamics and Diagnostics Branch, Washington, DC USA
Software for Generating Synthetic Passive Fourier Transform Infrared Interferograms and Single-beam Spectra ***Final Report, Oct. 1997 - Sep. 1998***
Shaffer, Ronald E.; Combs, Roger J.; Feb. 12, 1999; 61p; In English
Report No.(s): AD-A360501; NRL/MR/6110--99-8342; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Software routines for generating synthetic Fourier transform infrared (FT-IR) spectra and interferograms are documented. Infrared radiative transfer models for passive FT-IR spectroscopy are furnished, providing a basis for simulating realistic spectral data. Laboratory passive FT-IR spectra and interferograms are shown to validate the software performance. Due to variability in reported absorption coefficients, it is found that simulated data are not a replacement for either laboratory or field quantitative measurements. However, the synthetic data capability provides a versatile resource for examining experimental results and a flexible tool for chemometric research into various signal processing strategies for passive FT-IR spectroscopy. The software routines in the ”FTIR
DTIC
Infrared Spectroscopy; Computerized Simulation; Infrared Spectra; Fourier Transformation

19990032572 NASA Lewis Research Center, Cleveland, OH USA

Steady-State and Frequency Response of a Thin-Film Heat Flux Gauge

Fralick, Gustave C., NASA Lewis Research Center, USA; Bhatt, Hemanshu D., National Academy of Sciences - National Research Council, USA; Cho, Chistopher S., University of Western Michigan, USA; Journal of Spacecraft and Rockets; November 1997; Volume 34, No. 6, pp. 792-798; In English

Contract(s)/Grant(s): NAG3-1669; RTOP 523-26-13-OD; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A new and simpler design of thin-film heat flux gauge has been developed for use In high-heat-flux environments. Heat flux gauges of the same design were fabricated on three different substrates and tested. The heat flux gauge comprises a thermopile and a thermocouple junction, which measures the surface temperature. The thermopile has 40 pairs of S-type thermocouples and is covered by two thermal resistance layers. Calibration and testing of these gauges were first carried out in an arc-lamp calibration facility. Sensitivity of the gauge was discussed in terms of the relative conductivity and surface temperature. The heat flux calculated from the gauge output was In good agreement with the precalibrated standard sensor. The steady-state and the transient response characteristics of the heat flux gauge were also investigated using a carbon dioxide pulse laser as a heat source. The dynamic frequency response was evaluated in terms of the nondimensional amplitude ratio with respect to the frequency spectrum of a chopped laser bcam. The frequency response of the gauge was determined to be about 3 kHz. The temperature profiles in the thin-film heat flux gauge were obtained numerically in steady-state conditions using FLUENT and compared with the experimental results.

Author

Heat Flux; Thin Films; Frequency Response; Steady State; Thermocouples; Temperature Profiles; Surface Temperature; Gauge Theory

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LASERS AND MASERS

Includes parametric amplifiers. For related information see also 76 Solid-State Physics.

19990028392 Academy of Sciences (Russia), Chemical and Electric-Discharge Laser Lab., Samara, Russia

The Upgrade of COIL Facility in Lebedev Physical Institute (Samara Branch) ***Final Report***

Jan. 1998; 31p; In English

Contract(s)/Grant(s): F61775-98-W-E051

Report No.(s): AD-A360101; EOARD-SPC-98-4044; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The previous COIL facility in LPI (Samara Branch) consists of the jet type SOG operating at chlorine molar flow rate up to 20 mmole/ 5 and 5 cm gain length supersonic COIL. Pumping system consists of two mechanical pumps 180 1/s capacity and 4 m3 vacuum receiver. The iodine generator is able to generate 0.5 mmole/s of the iodine vapor molar flow rate. The chlorine feeding system is able to generate up to 30 mmole/s of chlorine molar flow rate during lOs. Several modifications have been made for COIL operation at higher chlorine flow rates (up to 100 mmole/s), at higher iodine flow rate (up to 2 mmole/s) and with He gas dilution:

DTIC

Chemical Lasers; Data Bases

19990028496 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Composite resonator vertical cavity laser diode

Choquette, K. D., Department of Energy, USA; Hou, H. Q., Department of Energy, USA; Chow, W. W., Department of Energy, USA; Geib, K. M., Department of Energy, USA; Hammons, B. E., Department of Energy, USA; May 31, 1998; 10p; In English; Lasers and electro-optics, USA

Report No.(s): DE98-004115; SAND-98-0517C; CONF-980529; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The use of two coupled laser cavities has been employed in edge emitting semiconductor lasers for mode suppression and frequency stabilization. The incorporation of coupled resonators within a vertical cavity laser opens up new possibilities due to the unique ability to tailor the interaction between the cavities. Composite resonators can be utilized to control spectral and temporal properties within the laser; previous studies of coupled cavity vertical cavity lasers have employed photopumped structures.

The authors report the first composite resonator vertical cavity laser diode consisting of two optical cavities and three monolithic distributed Bragg reflectors. Cavity coupling effects and two techniques for external modulation of the laser are described.
NTIS
Optical Resonators; Semiconductor Lasers; Laser Cavities; Lasers

19990028628 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Coupled resonator vertical cavity laser
Choquette, K. D., Department of Energy, USA; Chow, W. W., Department of Energy, USA; Hou, H. Q., Department of Energy, USA; Geib, K. M., Department of Energy, USA; Hammons, B. E., Department of Energy, USA; Jan. 31, 1998; 6p; In English; BIOS '98: Biomedical Optics, 1998, USA
Report No.(s): DE98-004761; SAND-98-0949C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The monolithic integration of coupled resonators within a vertical cavity laser opens up new possibilities due to the unique ability to tailor the interaction between the cavities. The authors report the first electrically injected coupled resonator vertical-cavity laser diode and demonstrate novel characteristics arising from the cavity coupling, including methods for external modulation of the laser. A coupled mode theory is used model the output modulation of the coupled resonator vertical cavity laser.
NTIS
Laser Cavities; Semiconductor Lasers; Resonators; Coupled Modes

19990031983 Department of Energy, Office of Energy Research, Washington, DC USA
First picosecond terawatt CO2 laser at the Brookhaven Accelerator Test Facility
Pogorelsky, I. V., Department of Energy, USA; Ben-Zvi, I., Department of Energy, USA; Babzien, M., Department of Energy, USA; Feb. 28, 1998; 10p; In English; Lasers and Applications, USA
Report No.(s): DE98-004433; BNL-65240; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The first terawatt picosecond CO2 laser was brought to operation at the Brookhaven Accelerator Test Facility in 1998. System consists of a single-mode TEA oscillator, picosecond semiconductor optical switch, multi-atmosphere. The authors report on design, simulation, and performance tests of the 10 atm final amplifier that allows for direct multi-joule energy extraction in a picosecond laser pulse.
NTIS
Carbon Dioxide Lasers; Performance Tests; Picosecond Pulses; Pulsed Lasers; Linear Accelerators

19990031984 Department of Energy, Office of Energy Research, Washington, DC USA
Emerging ps-TW CO2 laser technology for high energy physics applications
Pogorelsky, I. V., Department of Energy, USA; Feb. 28, 1998; 11p; In English; Lasers and Applications, USA
Report No.(s): DE98-004432; BNL-65238; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A brief overview of laser acceleration techniques and a comparative analysis of the picosecond terawatt (ps-TW) CO2 laser technology versus T(sup 3) solid state lasers for prospective HEP applications. Special attention is given to two laser accelerator schemes. The first one is the far-field staged laser accelerator, STELLA, which is under exploration at the ATF using a CO2 laser. The second is a laser wakefield accelerator where ps-TW CO2 lasers have a great potential. Inverse to the laser accelerator, a prospective monochromatic x-ray source feasible at the ATF will also utilize a 50 MeV subpicosecond electron beam and the first ps-TW CO2 laser, PITER I.
NTIS
Carbon Dioxide Lasers; Technology Assessment; Laser Applications; Electron Beams; User Requirements

19990032203 Academy of Sciences (USSR), Laser Materials and Technology Research Center, Moscow, USSR
Solid State Raman Materials Characterization for High Average Power 1.3 micrometer Laser Frequency Shift *Final Report*
Basiev, Tasoltan T.; Jan. 1999; 86p; In English
Contract(s)/Grant(s): F61775-98-W-E056
Report No.(s): AD-A360623; EOARD-SPC-98-4043; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This report results from a contract tasking Laser Materials and Technology Research Center of the General Physics Institute as follows: The contractor will evaluate the thermomechanical and optical properties, and conduct Raman spectroscopic studies

and laser laboratory tests to determine the most promising Raman frequency shifting materials for use with 1.3 micron high power lasers.
DTIC
Nonlinear Optics; Laser Materials; Solid State; Optical Properties; Laser Outputs; Raman Spectra

19990032427 Cornell Univ., Ithaca, NY USA
Monolithically Integrated Coupled-Laser All-Optical Switching and Routing Elements and Circuits ***Final Report, Feb. - Nov. 1998***
Robert, F.; Tang, C. L.; Feb. 1999; 17p; In English
Contract(s)/Grant(s): F30602-98-C-0010; AF Proj. 4600
Report No.(s): AD-A360506; AFRL-SN-RS-TR-1999-14; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Previous work on monolithically integrated coupled-laser all-optical switching elements and circuits showed that the threshold current for the in-plane lasers fabricated from wafers designed for vertical cavity surface emitting lasers (VCSEL) were too high to permit long-term room temperature continuous wave (cw) operation. Results on experiments aimed at reducing the threshold current for the coupled in-plane lasers are reported. Two approaches were evaluated: oxidation and lattice intermixing through zinc-diffusion. No definite reduction of the threshold current for the in-plane lasers was observed, even though oxidation did lead to marked improvement in the operation characteristics of the coupled VCSELs. Emphasis of current work is on determining the switching speed of such coupled-laser switching elements and circuits.
DTIC
Semiconductor Lasers; Optical Switching; Threshold Currents; Vertical Orientation; Emitters; Switching Circuits; Surface Emitting Lasers; Laser Cavities

19990032534 Department of Energy, Washington, DC USA
Mapping and inspection of damage and artifacts in large-scale optics
Rainer, F., Department of Energy, USA; Dec. 22, 1997; 13p; In English; 29th; Optical materials for high power lasers, USA
Report No.(s): DE98-052078; UCRL-JC-127902; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We have developed tools for accurately and economically mapping and inspecting damage and artifacts in the bulk as well as on the surface of meter-sized optics intended for use on large-scale lasers such as Beamlet and NIF. Optics are illuminated by white light through the optic edge or externally at grazing incidence using linear fiber-optics arrays. The mega-pixel camera records a digital map of the entire optic with precise addresses of highlighted artifacts. From these coordinated, artifacts are located and digitally recorded with resolution of less than 5 microns using a long-working-distance microscope. Total internal reflection of edge illumination efficiency couples light into the entire optic to inspect for bulk artifacts, such as bubbles, inclusions, edge-cladding flaws and laser-induced damage as well as surface scratches and pits which propagate into the substrate. Surface contamination such as dust, fingerprints, coating flaws, and cleaning flaws are highlighted by external grazing illumination. The procedures permit accurate recording of the evolution of damage after many laser shots as well as correlation of damage from one optic to the next in a laser chain.
NTIS
Mapping; Inspection; Artifacts; Fiber Optics; Laser Damage

19990032589 NASA Goddard Space Flight Center, Greenbelt, MD USA
Stable CW Single-Frequency Operation of Fabry-Perot Laser Diodes by Self-Injection Phase Locking
Duerksen, Gary L., Maryland Univ., USA; Krainak, Michael A., NASA Goddard Space Flight Center, USA; 1999; In English; CLEO '99, Apr. 1999, Baltimore, MD, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
Previously, single-frequency semiconductor laser operation using fiber Bragg gratings has been achieved by two methods: 1) use of the FBG as the output coupler for an anti-reflection-coated semiconductor gain element'; 2) pulsed operation of a gain-switched Fabry-Perot laser diode with FBG-optical and RF-electrical feedback. Here, we demonstrate CW single frequency operation from a non-AR coated Fabry-Perot laser diode using only FBG optical feedback. We coupled a nominal 935 run-wavelength Fabry-Perot laser diode to an ultra narrow band (18 pm) FBG. When tuned by varying its temperature, the laser wavelength is pulled toward the centerline of the Bragg grating, and the spectrum of the laser output is seen to fall into three discrete stability regimes as measured by the side-mode suppression ratio.
Derived from text
Injection Locking; Continuous Radiation; Semiconductor Lasers; Bragg Gratings; Couplers

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MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

19990028321 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Laser assisted non-consumable arc welding process development
Fuerschach, P. W., Department of Energy, USA; Hooper, F. M., Department of Energy, USA; Sep. 30, 1997; 3p; In English
Report No.(s): DE98-000341; SAND-97-2015C; CONF-980415; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The employment of Laser Beam Welding (LBW) for many traditional arc welding applications is often limited by the inability of LBW to compensate for variations in the weld joint gap. This limitation is associated with fluctuations in the energy transfer efficiency along the weld joint. Because energy transfer in arc welding does not similarly depend on weld pool geometry, it is expected that combining these two processes together will lead to an enhanced fusion welding process that exhibits the advantages of both arc welding and LBW. Laser assisted non-consumable arc welds have been made on thin section aluminum. The welds combine the advantages of arc welding and laser welding, with enhanced penetration and fusion zone size. The use of a pulsed Nd:YAG laser with the combined process appears to be advantageous since this laser is effective in removing the aluminum oxide and thereby allowing operation with the tungsten electrode negative. The arc appears to increase the size of the weld and also to mitigate hot cracking tendencies that are common with the pulsed Nd:YAG laser.
NTIS
Laser Welding; Arc Welding; Neodymium Lasers; Procedures; Technology Assessment; YAG Lasers

19990028604 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Prediction of packaging seal life using thermoanalytical techniques
Nigrey, P. J., Department of Energy, USA; Nov. 30, 1997; 10p; In English; 12th; PATRAM '98: Packaging and Transportation of Radioactive Material, 1998, USA
Report No.(s): DE98-001307; SAND-97-0854C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this study, Thermogravimetric Analysis (TGA) has been used to study silicone, Viton and Ethylene Propylene (EPDM) rubber. The studies have shown that TGA accurately predicts the relative order of thermo-oxidative stability of these three materials from the calculated activation energies. As expected, the greatest thermal stability was found in silicone rubber followed by Viton and EPDM rubber. The calculated lifetimes for these materials were in relatively close agreement with published values. The preliminary results also accurately reflect decreased thermal stability and lifetime for EPDM rubber exposed to radiation and chemicals. These results suggest TGA provides a rapid method to evaluate material stability.
NTIS
Radioactive Materials; Containers; Life (Durability); Seals (Stoppers); Research; Silicones; Viton Rubber (Trademark); Thermal Analysis

19990031852 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Electric Vehicle Fleet Operations in the USA
Francfort, J. E., Department of Energy, USA; OHara, D., Department of Energy, USA; Mar. 31, 1998; 10p; In English; Automotive Technology (ampersand) Automation, USA
Report No.(s): DE98-052575; INEEL/CON-98-00224; CONF-980619; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The US Department of Energy (DOE) is actively supporting the development and commercialization of advanced electric vehicles, batteries, and propulsion systems. As part of this effort, the DOE Field Operations Program is performing commercial validation testing of electric vehicles and supporting the development of an electric vehicle infrastructure. These efforts include the evaluation of electric vehicles in baseline performance, accelerated reliability, and fleet operations testing. The baseline performance testing focuses on parameters such as range, acceleration, and battery charging. This testing, performed in conjunction with EV America, has included the baseline performance testing of 16 electric vehicle models from 1994 through 1997. During 1997, the Chevrolet S10 and Ford Ranger electric vehicles were tested. During 1998, several additional electric vehicles from original equipment manufacturers will also be baseline performance tested. This and additional information is made available to the public via the Program's web page (http://ev.inel.gov/sop). In conjunction with industry and other groups, the Program also supports the Infrastructure Working Council in its development of electric vehicle communications, charging, health and safety, and power quality standards. The Field Operations Program continues to support the development of electric vehicles and infrastructure in conjunction with its qualified vehicle test partners: Electric Transportation Applications, and Southern California Edison. The

Field Operations Program is managed by the Lockheed Martin Idaho Technologies Company at the Idaho National Engineering and Environmental Laboratory.
NTIS
Electric Motor Vehicles; Electric Batteries; Electric Propulsion; Performance Tests; Roadway Powered Vehicles

19990032026 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Advanced gas turbine systems research ***Quarterly Report, 1 Oct. - 31 Dec. 1997***
Dec. 31, 1997; 50p; In English
Report No.(s): DE98-058977; DOE/MC/29061-12; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Major accomplishments by Advanced Gas Turbine Systems Research (AGTSR) during this reporting period are highlighted and then amplified in later sections of this report. Main areas of research are combustion, heat transfer, and materials. Gas turbines are used for power generation by utilities and industry and for propulsion.
NTIS
Gas Turbines; Gas Turbine Engines; Combustion; Heat Transfer

19990032028 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Advanced gas turbine systems research ***Quarterly Report, 1 Jul. - 30 Sep. 1997***
Dec. 31, 1997; 50p; In English
Report No.(s): DE98-058957; DOE/MC/29061-10; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Major accomplishments by Advanced Gas Turbine Systems Research (AGTSR) during this reporting period are highlighted and then amplified in later sections of this report. Main areas of research are combustion, heat transfer, and materials. Gas turbines are used for power generation by utilities and industry and for propulsion.
NTIS
Gas Turbines; Gas Turbine Engines; Combustion; Heat Transfer; Materials

19990032091 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Advanced gas turbine systems research ***Quarterly Report, 1 Apr. - 30 Jun. 1998***
Dec. 31, 1998; 50p; In English
Report No.(s): DE98-058958; DOE/MC/29061-13; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Major accomplishments by Advanced Gas Turbine Systems Research (AGTSR) during this reporting period are highlighted and then amplified in later sections of this report. Main areas of research are combustion, heat transfer, and materials. Gas turbines are used for power generation by utilities and industry and for propulsion.
NTIS
Gas Turbines; Combustion; Heat Transfer; Heat of Combustion

19990032136 Department of Energy, Office of Energy Research, Washington, DC USA
Improved tribological behavior of boron implanted Ti-6Al-4V
Baker, N. P., Department of Energy, USA; Walter, K. C., Department of Energy, USA; Nastasi, M., Department of Energy, USA; Mar. 31, 1998; 8p; In English
Report No.(s): DE98-004388; LA-UR-97-4984; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Boron implanted of Ti6Al4V has been conducted at combinations of 32 and 40 keV to supplement that done previously at 75 keV. Shallower boron depth profiles with higher B-concentrations in the Ti-64 surface have been obtained by tailoring the combinations of ion energy and dose. This work used three different ion energy and dose combinations of 4 x 10(exp 17) B-at/sq cm at 40 keV plus 2 x 10(exp 17) B-at/sq cm at 32 keV, 4 x 10(exp 17) B-at/sq cm) at 40 keV, and 4 x 10(exp 17) B-at/sq cm at 32 keV plus 2 x 10(exp 17) B-at/sq cm at 40 keV. Comparisons are made between Ti6Al4V with a shallow implanted boron depth profile, Ti6Al4V with a deeper boron depth profile and nitrogen implanted using a plasma source ion implantation process. It has been previously shown that while boron implanted Ti64 has a (approximately) 30% higher surface hardness than nitrogen implanted Ti64, the N-implantation reduced the wear coefficient of Ti64 by 25--120x, while B-implantation reduced the wear coefficient by 6.5x or less. The results show that no significant improvement is made in the wear resistance of boron implanted Ti6Al4V by increasing the concentration of boron at the surface from approximately 10% to 43%. Transmission electron microscopy (TEM) and selected area diffraction (SAD) indicated the formation of crystalline TiB in the implanted surface layer. Shallower depth profiles result in reductions of the Ti6Al4V wear coefficient by 6.5x or less which is the same result obtained earlier

with the deeper boron depth profile. Surface hardness of Ti6Al4V with shallower boron depth profiles was improved approximately 10% compared to the results previously acquired with deeper boron depth profiles.
NTIS
Vanadium Alloys; Ion Implantation; Titanium Alloys; Aluminum Alloys; Boron

19990032295 Department of Energy, Washington, DC USA
New method for predicting lifetime of seals from compression-stress relaxation experiments
Gillen, K. T., Department of Energy, USA; Keenan, M. R., Department of Energy, USA; Wise, J., Department of Energy, USA; Jun. 30, 1998; 32p; In English; 20th; Advances in the Stabilization and Controlled Degradation of Polymers, USA
Report No.(s): DE98-004528; SAND-98-0854C; CONF-980642; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Interpretation of compression stress-relaxation (CSR) experiments for elastomers in air is complicated by: (1) the presence of both physical and chemical relaxation and (2) anomalous diffusion-limited oxidation (DLO) effects. For a butyl material, the authors first use shear relaxation data to indicate that physical relaxation effects are negligible during typical high temperature CSR experiments. They then show that experiments on standard CSR samples ((approximately)15 mm diameter when compressed) lead to complex non- Arrhenius behavior. by combining reaction kinetics based on the historic basic autoxidation scheme with a diffusion equation appropriate to disk-shaped samples, they derive a theoretical DLO model appropriate to CSR experiments. Using oxygen consumption and permeation rate measurements, the theory shows that important DLO effects are responsible for the observed non-Arrhenius behavior. To minimize DLO effects, they introduce a new CSR methodology based on the use of numerous small disk samples strained in parallel. Results from these parallel, minidisk experiments lead to Arrhenius behavior with an activation energy consistent with values commonly observed for elastomers, allowing more confident extrapolated predictions. In addition, excellent correlation is noted between the CSR force decay and the oxygen consumption rate, consistent with the expectation that oxidative scission processes dominate the CSR results.
NTIS
Service Life; Elastomers; Procedures; Experimentation; Seals (Stoppers)

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QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

19990028461 Department of Energy, Washington, DC USA
Robust defect segmentation in woven fabrics
Sari-Sarraf, H., Department of Energy, USA; Goddard, J. S., Department of Energy, USA; Dec. 31, 1997; 10p; In English; Computer vision and pattern recognition, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-004216; ORNL/CP-96171; CONF-980629; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a robust segmentation algorithm for the detection and localization of woven fabric defects. The essence of the presented segmentation algorithm is the localization of those events (i.e., defects) in the input images that disrupt the global homogeneity of the background texture. To this end, preprocessing modules, based on the wavelet transform and edge fusion, are employed with the objective of attenuating the background texture and accentuating the defects. Then, texture features are utilized to measure the global homogeneity of the output images. If these images are deemed to be globally nonhomogeneous (i.e., defects are present), a local roughness measure is used to localize the defects. The utility of this algorithm can be extended beyond the specific application in this work, that is, defect segmentation in woven fabrics. Indeed, in a general sense, this algorithm can be used to detect and to localize anomalies that reside in images characterized by ordered texture. The efficacy of this algorithm has been tested thoroughly under realistic conditions and as a part of an on-line fabric inspection system. Using over 3700 images of fabrics, containing 26 different types of defects, the overall detection rate of this approach was 89% with a localization accuracy of less than 0.2 inches and a false alarm rate of 2.5%.
NTIS
Defects; Segments; Fabrics; Woven Composites; Detection

19990028761 Sandia National Labs., FAA Airworthiness Assurance NDI Validation Center, Albuquerque, NM USA
Experimental Flight Test Vibration Measurements and Nondestructive Inspection on a USCG HC-130H Aircraft
Moore, David G., Sandia National Labs., USA; Jones, Craig R., Sandia National Labs., USA; Mihelic, Joseph E., Coast Guard, USA; Barnes, James D., Coast Guard, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 811-820; In English; See also 19990028721
Contract(s)/Grant(s): DE-ACO4-94-AL85000; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper presents results of experimental flight test vibration measurements and structural inspections performed by the Federal Aviation Administration's Airworthiness Assurance NDI Validation Center (AANC) at Sandia National Laboratories and the U.S. Coast Guard Aircraft Repair and Supply Center (ARSC). Structural and aerodynamic changes induced by mounting a Forward Looking Infrared (FLIR) system on a USCG HC-130H aircraft are described. The FLIR adversely affected the air flow characteristics and structural vibration on the external skin of the aircraft's fight main wheel well fairing. Upon initial discovery of skin cracking and visual observation of skin vibration in flight by the FLIR, a baseline flight without the FLIR was conducted and compared to other measurements with the FLIR installed. Nondestructive inspection procedures were developed to detect cracks in the skin and supporting structural elements and document the initial structural condition of the aircraft. Inspection results and flight test vibration data revealed that the FLIR created higher than expected flight loading and was the possible source of the skin cracking. The Coast Guard performed significant structural repair and enhancement on this aircraft, and additional in-flight vibration measurements were collected on the strengthened area both with and without the FLIR installed. After three months of further operational FLIR usage, the new aircraft skin with the enhanced structural modification was reinspected and found to be free of flaws. Additional U.S. Coast Guard HC-130H aircraft are now being similarly modified to accommodate this FLIR system. Measurements of in-flight vibration levels with and without the FLIR installed, and both before and after the structural enhancement and repair were conducted on the skin and supporting structure in the aircraft's right main wheel fairing. Inspection results and techniques developed to verify the aircraft's structural integrity are also discussed.
Author
Vibration Measurement; Structural Vibration; Aircraft Structures; Structural Analysis; Skin (Structural Member); Cracking (Fracturing); Fairings

19990028798 Sandia National Labs., Airworthiness Assurance NDI Validation Center, Albuquerque, NM USA
Detection Reliability for Small Cracks Beneath Rivet Heads Using Eddy-Current Nondestructive Inspection Techniques *Final Report*
Spencer, F. W., Sandia National Labs., USA; Dec. 1998; 62p; In English
Report No.(s): PB99--126864; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In order to assess the full potential of advanced eddy-current inspection technology on representative aircraft applications, the FAA's Airworthiness Assurance Nondestructive Inspection Validation Center (AANC) was tasked to assess the full capability of several advanced systems. The task involved inspections of several rivet skin splices--representative of actual aircraft structure--containing cracks ranging from 0.040-, 0.060-, and 0.080-inch standards, and thresholds were set to the lowest reasonable level for the particular system. The results demonstrated that some of the systems were able to reliably detect cracks as small as 0.040 inch with false call rates remained less than 1%.
NTIS
Crack Propagation; Aircraft Structures; Detection; Rivets; Reliability Analysis

19990032551 Department of Energy, Washington, DC USA
Role of nondestructive evaluation in life cycle management
Martz, H., Department of Energy, USA; Dec. 18, 1997; 22p; In English; 3rd; Frontiers of engineering, USA
Report No.(s): DE98-052213; UCRL-JC-128400; CONF-9709203; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper provides an overview of some common nondestructive evaluation (NDE) methods and several examples for the use of different NDE techniques throughout the life cycle of a product. NDE techniques are being used to help determine material properties, design new implants, extend the service life of aircraft, and help dispose of radioactive waste in a safe manner. The NDE community needs to work more closely with end users in the life cycle of a product to better incorporate NDE techniques. The NDE community needs to highlight the importance of NDE in the entire life-cycle process of a product by showing real costs savings to the manufacturing community.
NTIS
Nondestructive Tests; Service Life

39
STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

19990028528 Department of Energy, Washington, DC USA
ALEGRA -- code validation: Experiments and simulations
Chhabildas, L. C., Department of Energy, USA; Konrad, C. H., Department of Energy, USA; Mosher, D. A., Department of Energy, USA; Reinhart, W., Department of Energy, USA; Duggins, B. D., Department of Energy, USA; Mar. 16, 1998; 10p; In English; SUSI 1998: structures under shock and impact, USA
Report No.(s): DE98-004234; SAND-98-0674C; CONF-980624; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this study, the authors are providing an experimental test bed for validating features of the ALEGRA code over a broad range of strain rates with overlapping diagnostics that encompass the multiple responses. A unique feature of the Arbitrary Lagrangian Eulerian Grid for Research Applications (ALEGRA) code is that it allows simultaneous computational treatment, within one code, of a wide range of strain-rates varying from hydrodynamic to structural conditions. This range encompasses strain rates characteristic of shock-wave propagation 10(exp 7)/s and those characteristic of structural response 10(exp 2)/s. Most previous code validation experimental studies, however, have been restricted to simulating or investigating a single strain-rate regime. What is new and different in this investigation is that the authors have performed well-instrumented experiments which capture features relevant to both hydrodynamic and structural response in a single experiment. Aluminum was chosen for use in this study because it is a well characterized material--its EOS and constitutive material properties are well defined over a wide range of loading rates. The current experiments span strain rate regimes of over 10(exp 7)/s to less than 10(exp 2)/s in a single experiment. The input conditions are extremely well defined. Velocity interferometers are used to record the high strain-rate response, while low strain rate data were collected using strain gauges.
NTIS
Simulation; Codes; Test Stands; Proving

19990028721 NASA Langley Research Center, Hampton, VA USA
The Second Joint NASA/FAA/DoD Conference on Aging Aircraft, Part 2
Harris, Charles E., Editor, NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999; 611p; In English; 2nd; Aging Aircraft, 31 Aug. - 3 Sep. 1998, Williamsburg, VA, USA; Sponsored by NASA Langley Research Center, USA; See also 19990028722 through 19990028771
Contract(s)/Grant(s): RTOP 538-10
Report No.(s): NASA/CP-1999-208982/PT2; L-17819B; NAS 1.55:208982/PT2; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The purpose of the Conference was to bring together world leaders in aviation safety research, aircraft design and manufacturing, fleet operation and aviation maintenance to disseminate information on current practices and advanced technologies that will assure the continued airworthiness of the aging aircraft in the military and commercial fleets. The Conference included reviews of current industry practices, assessments of future technology requirements, and status of aviation safety research. The Conference provided an opportunity for interactions among the key personnel in the research and technology development community, the original equipment manufacturers, commercial airline operators, military fleet operators, aviation maintenance, and aircraft certification and regulatory authorities. Conference participation was unrestricted and open to the international aviation community. Appendix B contains the name and addresses of the 623 participants in the Conference.
Author
Conferences; Aircraft Reliability; Structural Analysis; Fracture Mechanics; Cracking (Fracturing); Crack Propagation; Aircraft Structures; Aging (Materials); Structural Failure; Fault Detection; Fatigue (Materials)

19990028722 Technische Univ., Inst. of Aircraft Design and Lightweight Structures, Brunswick, Germany
On the Assessment of the Criticality of Crack Scenarios with Respect to Widespread Fatigue Damage
Horst, Peter, Technische Univ., Germany; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 387-396; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The main question in the assessment of Widespread Fatigue Damage (WFD) criticality is the question how critical certain crack and crack initiation scenarios are, with or without combination with the residual strength problem. This paper deals with methods for the assessment of the criticality of crack scenarios. Emphasis is put on the question of deteriorating effects.
Author
Aircraft Structures; Fatigue (Materials); Crack Initiation; Cracks; Deterioration; Damage

19990028723 NASA Langley Research Center, Hampton, VA USA
The Growth of Multi-Site Fatigue Damage in Fuselage Lap Joints
Piascik, Robert S., NASA Langley Research Center, USA; Willard, Scott A., Lockheed Engineering and Sciences Co., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 397-407; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Destructive examinations were performed to document the progression of multi-site damage (MSD) in three lap joint panels that were removed from a full scale fuselage test article that was tested to 60,000 full pressurization cycles. Similar fatigue crack growth characteristics were observed for small cracks (50 microns to 10 mm) emanating from counter bore rivets, straight shank rivets, and 100 deg counter sink rivets. Good correlation of the fatigue crack growth data base obtained in this study and FASTRAN Code predictions show that the growth of MSD in the fuselage lap joint structure can be predicted by fracture mechanics based methods.
Author
Fuselages; Lap Joints; Riveted Joints; Damage; Crack Propagation; Fatigue (Materials); Short Cracks; Crack Initiation; Damage Assessment

19990028724 NASA Langley Research Center, Hampton, VA USA
Residual Strength Pressure Tests and Nonlinear Analyses of Stringer- and Frame-Stiffened Aluminum Fuselage Panels with Longitudinal Cracks
Young, Richard D., NASA Langley Research Center, USA; Rouse, Marshall, NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Starnes, James H., Jr., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 408-426; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The results of residual strength pressure tests and nonlinear analyses of stringer- and frame-stiffened aluminum fuselage panels with longitudinal cracks are presented. Two types of damage are considered: a longitudinal crack located midway between stringers, and a longitudinal crack adjacent to a stringer and along a row of fasteners in a lap joint that has multiple-site damage (MSD). In both cases, the longitudinal crack is centered on a severed frame. The panels are subjected to internal pressure plus axial tension loads. The axial tension loads are equivalent to a bulkhead pressure load. Nonlinear elastic-plastic residual strength analyses of the fuselage panels are conducted using a finite element program and the crack-tip-opening-angle (CTOA) fracture criterion. Predicted crack growth and residual strength results from nonlinear analyses of the stiffened fuselage panels are compared with experimental measurements and observations. Both the test and analysis results indicate that the presence of MSD affects crack growth stability and reduces the residual strength of stiffened fuselage shells with long cracks.
Author
Fuselages; Load Tests; Structural Analysis; Crack Tips; Finite Element Method; Cracking (Fracturing); Surface Cracks; Crack Propagation

19990028725 Lockheed Martin Aeronautical Systems, Marietta, GA USA
Residual Strength Analysis of Skin Splices with Multiple Site Damage
Ingram, J. E., Lockheed Martin Aeronautical Systems, USA; Kwon, Y. S., Lockheed Martin Aeronautical Systems, USA; Duffie, K. J., Lockheed Martin Aeronautical Systems, USA; Irby, W. D., Lockheed Martin Aeronautical Systems, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 427-436; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The widespread fatigue damage (WFD) assessment of the L-1011 aircraft has necessitated a significant update to the damage tolerance analysis methods at Lockheed Martin Aeronautical Systems (LMAS). This paper describes the methods of analysis, which will be used to predict the effect of multiple site damage (MSD) cracks on the residual strength of WFD-susceptible locations of the airframe. The STAGS finite element code is used to develop an enhanced engineering approach for calculating the lead crack and MSD crack link-up stresses in ductile alloys. This approach involves using the crack tip opening angle (CTOA) as a criteria for crack extension in STAGS models of various multiple-crack configurations. to study the fastener load redistribution in lap splices containing lead and MSD cracks, detailed nonlinear solid element models were constructed using the Lockheed

Martin DIAL finite element code. These lap joint models were run for numerous configurations of lead and MSD cracks, and show the effect of fastener load peaking and shedding as the lead crack approaches and emerges from MSD-cracked fastener holes. The results of these nonlinear calculations are used to develop a code for residual strength, based on crack link-up (using the enhanced engineering approach) when the linear-elastic stress intensity solution is known from detailed models of more complex wing and fuselage structure.
Author
Residual Strength; Structural Analysis; Fatigue (Materials); Damage; Cracks; Finite Element Method; Crack Propagation; Airframes; Skin (Structural Member)

19990028726 Air Force Research Lab., Wright-Patterson AFB, OH USA
Fatigue Crack Growth Predictions in Riveted Joints
Fawaz, S. A., Air Force Research Lab., USA; Schijve, J., Technische Univ., Netherlands; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 437-451; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A characteristic aspect of fatigue of riveted lap joints is the occurrence of crack growth under a complex stress system, which in its simplest form consists of cyclic tension with superimposed cyclic bending due to the eccentricity in the lap joint. In reality, rivet squeezing leads to hole expansion and built-in residual stresses. In the empirical part of the investigation a simpler problem was analyzed first, i.e. fatigue crack growth in a multiple-hole sheet specimen loaded under combined tension and bending stress. Crack growth development for small part-through cracks could be followed by fractographic observations employing marker load cycles in between constant-amplitude loading. The same marking technique was employed for a simple lap joint having two rivet rows with four rivets in each row. The crack growth history could be reconstructed from a crack length of 75 microns to final fracture at 12 mm. In the analytical part, the well-known Newman-Raju K-solutions are available for part-through cracks. After through cracks are obtained they continue to grow with oblique crack fronts due to the combined tension and bending. Since no K-solutions are available for these cracks, the finite-element method and a three dimensional virtual crack closure technique (3D VCCT) were adopted. K-solutions for the crack shapes obtained in the open hole sheet specimen lap joint experiments are then calculated and adopted for the prediction of the growth of these cracks. A satisfactory agreement has been obtained. K-values have been calculated for a range of crack depth to crack length ratios, crack depth to sheet thickness ratios, and hole radius to sheet thickness ratios. The Newman/Raju K-solutions and newly calculated K-solutions for the through cracks have been incorporated into a crack growth prediction scheme. The prediction algorithm not only predicts the fatigue life within 6% of the actual life, but also accurately predicts the crack growth history until just prior to final fracture.
Author
Riveted Joints; Lap Joints; Fatigue (Materials); Crack Propagation; Crack Geometry; Finite Element Method; Structural Analysis; Fuselages

19990028727 United Technologies Research Center, Product Integrity, East Hartford, CT USA
Nonplanar Fatigue Crack Growth in 7075-T73 Aluminum
Forth, Scott C., United Technologies Research Center, USA; Favrow, Leroy H., United Technologies Research Center, USA; Keat, William D., Union Coll., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 452-461; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A specimen geometry and experimental procedure have been designed for characterizing the fatigue crack growth behavior of 7075-T73 aluminum under mixed-mode loading conditions. Specimens were prepared with semi-circular EDM flaws oriented at angles of 30, 45 and 60-degrees with respect to the applied tensile loading to induce nonplanar crack growth. Multiple tests run at each crack geometry/loading condition indicate that an acceptable level of repeatability has been attained. The experimental results were used to assess analytical models of crack growth, ranging from a projection technique to a fully three-dimensional simulator of nonplanar crack growth based on the surface integral method.
Author
Aluminum Alloys; Crack Propagation; Specimen Geometry; Metal Fatigue; Load Tests; Mathematical Models

19990028728 Georgia Tech Research Inst., Atlanta, GA USA
Quantifying Spectrum Loading Effects on Fatigue Crack Growth
Zion, H. Lewis, Georgia Tech Research Inst., USA; Johnson, W. Steven, Georgia Inst. of Tech., USA; Ball, Dale L., Lockheed Martin Tactical Aircraft Systems, USA; Everett, Richard A., Jr., Army Vehicle Structures Lab., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 462-471; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The combined effects of four variables on calculated spectrum fatigue crack growth (FCG) were compared using an experimental design approach (NASGRO 3.0 adaptation). The four parameters which were considered were: (1) load interaction, (2) load sequence (rainflow counted low-to-high, rainflow counted and randomized, and rainflow counted high-to-low), (3) crack tip stress state (plane stress versus plane strain) and (4) spectrum type (FELIX-28 helicopter rotor blade spectrum versus F-16 wing root bending moment spectrum). Each of the three load interaction models available in NASGRO 3.0 was used to compute load interaction effects. The investigation concluded that the order of cycles and crack tip constraint play relatively minor roles in computed FCG for problems involving repeated application of either of the given spectra, while the effects of the spectrum type itself, inclusion of load interaction effects and the synergy of spectrum with load interaction are highly significant.
Author
Load Tests; Crack Propagation; Aircraft Structures; Fatigue (Materials); Stress Cycles

19990028729 Boeing Information, Space and Defense Systems, Wichita, KS USA
Analytic Framework for Assessment of Corrosion and Fatigue in Fuselage Lap Joint
Cope, Dale A., Boeing Information, Space and Defense Systems, USA; Johnson, Patrick S., Boeing Information, Space and Defense Systems, USA; Trego, Angela, Boeing Information, Space and Defense Systems, USA; West, J. Doug, Boeing Information, Space and Defense Systems, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 472-481; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper discusses the development and demonstration of the Corrosion Damage Assessment Framework (CDAF). Two specific concerns that could affect safety limits for aging aircraft are the effects of corrosion damage and widespread fatigue damage (WFD) on structural integrity. This project evaluated the capabilities of several advanced analysis tools for assessing these effects on the structural integrity of riveted lap joints. In constructing the framework, Boeing evaluated existing structural analysis tools capable of performing stress analysis, fatigue crack propagation analysis, and structural failure risk assessment. to validate the tools, analyses were conducted on and compared to experimental test data from a previous research effort. This paper summarizes the tools and procedures used in the analytical framework and the analysis results of the experimental test. Under the CDAF project, the advanced structural analysis tools that were evaluated included: (1) Finite-element code, FRANC2D/L for determining stress distributions and stress intensity factors of cracks; (2) Crack growth analysis code, AFGROW, for estimating fatigue crack growth life; and (3) Risk analysis code, PROF, for determining the probability of fracture. The framework outlines the approaches used to provide the input data for each analytical tool, the procedures required to accomplish the analyses, and the processes to transfer data between the various analytical tools. These existing structural analysis tools were evaluated for their capabilities to address crevice corrosion and multiple site damage (MSD) associated with WFD in fuselage lap joints. to validate the analysis tools, one of the case studies performed compared analysis results to experimental test data on lap joint coupon specimens with and without corrosion. The evaluations investigated the tools' capabilities to account for two primary effects of crevice corrosion - material thinning and corrosion pillowing- and for two primary effects of WFD - MSD cracks and small cracks (cracks less than 0.05-in). The tools demonstrated the capabilities to perform stress analysis, crack growth analysis, and risk analysis on thin structural components with multiple layers of material and multiple cracks. Analysis results showed good agreement between predicted and experimental fatigue life for both the baseline and corroded configurations. Evaluations showed that analysis tools could account for material thinning and MSD cracks, but limitations in some of the tools prevented a complete evaluation that accounted for corrosion pillowing or small cracks. With further improvements in analysis tools and techniques, the analytical framework would be useful in assessing the impact of corrosion damage and MSD on the integrity of an aircraft structural component.
Author
Damage Assessment; Fatigue (Materials); Fuselages; Lap Joints; Structural Analysis; Finite Element Method; Crack Propagation; Cavitation Corrosion

19990028730 CC Technologies Labs., Inc., Dublin, OH USA
Mathematical Model to Predict Fatigue Crack Initiation in Corroded Lap Joints
Koch, Gerhardus H., CC Technologies Labs., Inc., USA; Yu, Le, Ohio State Univ., USA; Katsube, Noriko, Ohio State Univ., USA; Paul, Clare A., Air Force Research Lab., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 482-492; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

There is increasing concern about the possible detrimental effects of corrosion on the structural integrity of fuselage lap joints. Corrosion in lap joints can lead to a decrease in strength because of loss in skin thickness, early fatigue crack initiation caused by the formation of stress risers, and increased fatigue crack growth rates. The mode of corrosion in lap joints has generally been considered to be uniform loss of material. Based on the concept of general thickness loss and the formation of voluminous corrosion products as a result of exfoliation corrosion, models to predict the stress distribution and fatigue crack initiation sites have

been previously developed. These models indicate that that the combination of loss in skin thickness and the build up of voluminous corrosion products inside the lap joint will lead to high stresses in the joint where fatigue cracks are likely to initiate. However, these calculations are not based on the actual morphology of corrosion in the lap joint. In this paper, detailed metallography of a KC-135 lap-joint section describes the complex nature of corrosion on the contact or faying surface, with barely detectable corrosion penetrating deep into the skin. A finite element model was developed, based on the actual corrosion morphology of the lap joint. The finite element program ABAQUS was used to model the strain/stress distribution in a corroded lap-joint section. The corrosion was simulated by decreasing the skin thickness and applying a uniform pressure to represent the build up of corrosion by-products. A small hemisphere was introduced to simulate the localized intergranular corrosion. The results of the finite element analysis demonstrated that even a small hemispherical indent superimposed on uniform type corrosion near a fastener hole resulted in significant increase in elastic strain such that early fatigue crack initiation could be anticipated.
Author

Mathematical Models; Fatigue (Materials); Crack Propagation; Lap Joints; Fuselages; Intergranular Corrosion; Finite Element Method; Structural Analysis

19990028731 Department of Transportation, Volpe National Transportation Systems Center, Cambridge, MA USA

Analytical and Test Evaluations on the Linkup of Multiple Cracking in Stiffened Fuselage Panels

Jeong, David Y., Department of Transportation, USA; Bakuckas, John G., Jr., Hughes Technical Center, USA; Samavedam, Gopal, Foster-Miller Associates, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 493-502; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper describes testing and analysis of stiffened curved fuselage panels containing multiple cracks. Testing was conducted on a fabricated panel with various cracking configurations. The typical cracking scenario was a main lead crack with multiple smaller collinear cracks. Engineering analyses were conducted to predict the remote stress at linkup. These analyses were carried out with a displacement compatibility model in conjunction with analytically derived expressions for the bulging factor. The expression for the bulging factor included empirical constants which were determined from curve fitting of finite element results. Estimates for linkup are based on assuming that linkup occurs from plastic collapse of ligaments between adjacent cracktips. The engineering analyses provided reasonable but conservative estimates for the remote stress at linkup, in most cases (i.e., the predicted values were lower than the experimental values). In general, the predicted linkup stresses are within 25% of the experimentally measured values. Further work is needed to improve the accuracy of the approach used in this paper, particularly in validating the effect of bulging in pressurized stiffened curved panels.
Author

Fuselages; Curved Panels; Crack Propagation; Finite Element Method; Structural Analysis

19990028732 Alcoa Technical Center, Alcoa Center, PA USA

Benefits of Improved Fuselage Skin Sheet Alloy 2524-T3 in Multi-Site Damage Scenarios

Bray, Gary H., Alcoa Technical Center, USA; Bucci, Robert J., Alcoa Technical Center, USA; Kulak, Michael, Alcoa Technical Center, USA; Warren, Charles J., Alcoa Technical Center, USA; Grandt, Alten F., Jr, Purdue Univ., USA; Golden, Patrick J., Purdue Univ., USA; Sexton, Darren G., Purdue Univ., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 503-512; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper quantifies the improved resistance to the consequences of multi-site damage (MSD) that can develop in older aircraft provided by new Alcoa aluminum fuselage skin sheet alloy 2524-T3. Results from three types of tests are presented for 2524-T3 and the incumbent fuselage skin sheet alloy 2024-T3: (1) residual strength tests to assess the effect of multi-site damage on residual strength of unstiffened and stiffened flat panels; (2) fatigue tests on unstiffened flat panels to assess the effects of multi-site damage on fatigue life; and (3) fatigue tests on multi-hole coupons with and without prior corrosion to evaluate the resistance of each alloy to naturally occurring MSD. The results indicate that alloy 2524 offers improved structural damage tolerance in the presence of MSD due to its superior fatigue crack growth resistance and fracture toughness and is more resistant to MSD from corrosion in bare sheet form. The residual strength of 2524 panels containing a lead crack with MSD at adjacent holes was 8.8 to 10.4% higher than 2024 panels and the average fatigue life 27 to 45% longer depending on MSD flaw size. The two alloys had equivalent resistance to MSD from fatigue alone but the mean flaw areas following corrosion and fatigue were 18% smaller in bare 2524 than in bare 2024 and the corroded area alone 32% smaller. Potential advantages of the improved damage tolerance of 2524-T3 to aircraft manufacturer/operators are weight savings, lower operating costs, easier inspectability and increased safety.
Author

Aluminum Alloys; Fuselages; Residual Strength; Fatigue Tests; Crack Propagation; Damage; Structural Analysis; Corrosion Resistance; Skin (Structural Member)

19990028733 NASA Langley Research Center, Hampton, VA USA

Fracture Analysis of the FAA/NASA Wide Stiffened Panels

Seshadri, B. R., National Academy of Sciences - National Research Council, USA; Newman, J. C., Jr., NASA Langley Research Center, USA; Dawicke, D. S., NASA Langley Research Center, USA; Young, R. D., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 513-524; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper presents the fracture analyses conducted on the FAA/NASA stiffened and unstiffened panels using the STAGS (STructural Analysis of General Shells) code with the critical crack-tip-opening angle (CTOA) fracture criterion. The STAGS code with the ”plane-strain” core option was used in all analyses. Previous analyses of wide, flat panels have shown that the high-constraint conditions around a crack front, like plane strain, has to be modeled in order for the critical CTOA fracture criterion to predict wide panel failures from small laboratory tests. In the present study, the critical CTOA value was determined from a wide (unstiffened) panel with anti-buckling guides. The plane-strain core size was estimated from previous fracture analyses and was equal to about the sheet thickness. Rivet flexibility and stiffener failure was based on methods and criteria, like that currently used in industry. STAGS and the CTOA criterion were used to predict load-against-crack extension for the wide panels with a single crack and multiple-site damage cracking at many adjacent rivet holes. Analyses were able to predict stable crack growth and residual strength within a few percent (5%) of stiffened panel tests results but over predicted the buckling failure load on an unstiffened panel with a single crack by 10%.

Author

Fracture Mechanics; Structural Analysis; Applications Programs (Computers); Crack Propagation; Residual Strength; Finite Element Method; Aircraft Structures

19990028734 Wichita State Univ., Dept. of Aerospace Engineering, Wichita, KS USA

Improved Engineering Methods for Determining The Critical Strengths of Aluminum Panels with Multiple Site Damage in Aging Aircraft

Smith, Bert, Wichita State Univ., USA; Mouak, Adil, Wichita State Univ., USA; Saville, Perry, Wichita State Univ., USA; Myose, Roy, Wichita State Univ., USA; Horn, Walter, Wichita State Univ., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 525-534; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

An aging aircraft accumulates widespread fatigue damage commonly referred to as multiple site damage (MSD). For ductile materials such as 2024-T3 aluminum, MSD may lower the critical (residual) strength below that which is predicted by conventional fracture mechanics. An analytical model generally referred to as the linkup model (or the plastic zone touch model) has previously been used to describe this phenomenon. However, the linkup model has been shown to produce inaccurate results for many configurations. This paper describes two modifications of the linkup model that have been shown to predict accurate results over a wide range of configurations for both unstiffened and stiffened flat 2024-T3 panels with MSD at open holes.

Author

Aircraft Structures; Aluminum Alloys; Fatigue (Materials); Mathematical Models; Residual Strength; Damage; Fracture Mechanics

19990028735 National Research Council of Canada, Structures, Materials and Propulsion Lab., Ottawa, Ontario Canada

Corrosion Pillowing Cracks in Fuselage Joints

Bellinger, Nicholas C., National Research Council of Canada, Canada; Komorowski, Jerzy P., National Research Council of Canada, Canada; Gould, Ron W., National Research Council of Canada, Canada; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 535-544; In English; See also 19990028721; Sponsored in part by; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In a previous study carried out at the National Research Council Canada, pillowing in a fuselage lap joint caused by the presence of corrosion products was shown to result in a stress gradient through the skin thickness. This gradient led to a very high stress along the faying surface of the outer skin and a decreased stress on the outer surface. Consequently, it was shown that corrosion pillowing could cause the formation of semi-elliptical cracks with a high aspect ratio. In recent tear-down inspections, these types of cracks have been found on the faying surfaces of disassembled corroded circumferential and longitudinal lap joints. These joints were obtained from both retired and operational aircraft. The majority of the cracks discovered had not penetrated through to the surface, although some had lengths in excess of 6.35 mm (0.25 in.). All the fracture surfaces showed extensive intergranular crack-

ing with numerous secondary cracks. Fatigue striations were observed on some of the crack surfaces. None of the cracks were found using conventional nondestructive inspection techniques typically used for lap splice inspection.
Author
Fuselages; Lap Joints; Structural Analysis; Cracks; Skin (Structural Member); Corrosion

19990028736 Cambridge Univ., Engineering Dept., Cambridge, UK
Towards a Predictive Design Methodology for Composite Laminate Patches Based on Physical Modeling of Failure Processes
Beaumont, Peter W. R., Cambridge Univ., UK; Greer, James M., Jr., Air Force Academy, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 545-554; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A predictive design methodology has been developed for composite materials and structures based explicitly on analytical models of the physical processes (phenomena) by which damage accumulates. This methodology has been successfully applied to a variety of advanced strategic composite material systems. The effects of environment, temperature, and moisture, for instance, are also included in this modeling strategy. It would be desirable to reformulate this phenomena-based micromechanics model for application to composite-bonded repairs of metallic structures. This reformulation would allow the model to be applied to (1) empirical models of composite patch behavior (to provide a predictive capability), (2) existing finite element models (to ensure the widest possible utility to the design and application of composite patches to cracked aircraft structures), and (3) the design of software, including existing material and patch optimization codes (to aid implementation at all stages of the predictive design process and application). The major objective is to successfully apply this physical model of damage growth in a format suitable for the predictive design of notch-insensitive, damage tolerant composite-metal patch systems for application in hostile environments, including extremes of temperature. It is the intent that the form of these models will be suitable for incorporating into existing design software, e.g., as a constitutive law sub-routine for a finite element code and a sub-routine of an optimization code for patch design. This paper describes and assesses this design methodology as it has been applied to composites, and suggests how it might be applied to the technology of composite repairs to metallic structures.
Author
Aircraft Structures; Composite Materials; Mathematical Models; Micromechanics; Prediction Analysis Techniques; Cumulative Damage; Laminates; Design Analysis

19990028737 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Materials Research, Cologne, Germany
A CTOD Approach to Assess Stable Tearing Under Complex Loading Conditions
Donne, Claudio Dalle, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 555-564; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

An engineering approach for assessing the ductile fracture of cracked thin structures based on the delta(sub 5) crack tip opening displacement (ctod) is presented. Standard laboratory tests and experiments with biaxially loaded cruciform specimens of 6 mm thick 2024-T3 sheets showed that the delta(sub 5)-R-curves were reasonably independent of specimen geometry and applied loading conditions over almost the entire testing range. This was also found for inclined pre-cracks (mixed-mode I/II) and small cracks emanating from notches under biaxial loading. Only negative biaxial loading ratios, which lowered dramatically the constraint of plastic deformation ahead of the crack tip, led to an apparent increase of crack resistance. These constraint effects could however be quantified through a second parameter based on the linear elastic T-stress. The driving force was estimated with the Engineering Treatment Method (ETM), which required only the stress intensity factor and plastic limit load solutions of the considered structure as well as the material stress and strain power law as input parameters. The ETM predictions of delta(sub 5)-driving force were compared to the experimentally measured ctod values.
Author
Crack Tips; Ductility; Fracturing; Tearing; Crack Opening Displacement; Cracking (Fracturing); Mathematical Models; Aircraft Structures

19990028738 NASA Langley Research Center, Hampton, VA USA
Residual Strength Predictions with Crack Buckling
Dawicke, D. S., NASA Langley Research Center, USA; Gullerud, A. S., Illinois Univ., USA; Dodds, R. H., Jr., Illinois Univ., USA; Hampton, R. W., NASA Ames Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 565-574; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Fracture tests were conducted on middle crack tension, M(T), and compact tension, C(T), specimens of varying widths, constructed from 0.063 inch thick sheets of 2024-T3 aluminum alloy. Guide plates were used to restrict out-of-plane displacements in about half of the tests. Analyses using the three-dimensional, elastic-plastic finite element code WARP3D simulated the tests with and without guide plates using a critical CTOA fracture criterion. The experimental results indicate that crack buckling reduced the failure loads by up to 40%. Using a critical CTOA value of 5.5 deg., the WARP3D analyses predicted the failure loads for the tests with guide plates within +/- 10% of the experimentally measured values. For the M(T) tests without guide plates, the WARP3D analyses predicted the failure loads for the 12 and 24 inch tests within 10%, while over predicting the failure loads for the 40 inch wide tests by about 20%.

Author

Buckling; Residual Strength; Finite Element Method; Failure Analysis; Structural Analysis; Aircraft Structures; Crack Tips; Cracking (Fracturing); Crack Opening Displacement; Applications Programs (Computers); Mathematical Models

19990028739 NASA Langley Research Center, Hampton, VA USA

A Mixed-Mode I/II Fracture Criterion and Its Application in Crack Growth Predictions

Sutton, Michael A., South Carolina Univ., USA; Deng, Xiaomin, South Carolina Univ., USA; Ma, Fashang, South Carolina Univ., USA; Newman, James S., Jr., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 575-583; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A crack tip opening displacement (CTOD)-based, mixed mode fracture criterion is developed for predicting the onset and direction of crack growth. The criterion postulates that crack growth occurs in either the Mode I or Mode II direction, depending on whether the maximum in either the opening or the shear component of CTOD, measured at a specified distance behind the crack tip, attains a critical value. For crack growth direction prediction, the proposed CTOD criterion is shown to be equivalent to seven commonly used crack growth criteria under linearly elastic and asymptotic conditions. Under elastic-plastic conditions the CTOD criterion's prediction of the dependence of the crack growth direction on the crack-up mode mixity is in excellent agreement with the Arcan test results. Furthermore, the CTOD criterion correctly predicts the existence of a crack growth transition from mode I to mode II as the mode mixity approaches the mode II loading condition. The proposed CTOD criterion has been implemented in finite element crack growth simulation codes Z1P2DL and FRANC2DL to predict the crack growth paths in (a) a modified Arcan test specimen and fixture made of AL 2024-T34 and (b) a double cantilever beam (DCB) specimen made of AL 7050. A series of crack growth simulations have been carried out for the crack growth tests in the Arcan and DCB specimens and the results further demonstrate the applicability of the mixed mode CTOD fracture criterion crack growth predictions and residual strength analyses for airframe materials.

Author

Computerized Simulation; Crack Propagation; Fracturing; Crack Opening Displacement; Applications Programs (Computers); Finite Element Method; Airframe Materials

19990028740 Aeronautical Research Inst. of Sweden, Bromma, Sweden

Yield Strip Models for Residual Strength of MSD Damaged Curved and Flat Panels

Nilsson, Karl-Frederik, Aeronautical Research Inst. of Sweden, Sweden; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 584-597; In English; See also 19990028721

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The paper presents a yield-strip model to compute the residual strength of structures damaged by multiple site damage (MSD) and two particular applications. The first presents a parameter study of a stiffened sheet where the influence of crack patterns, and crack sizes and crack growth resistance are investigated. This study showed that the residual strength reduction was more pronounced for crack growth resistant materials, that also very small cracks may have a large impact and that cracking at tear straps is particularly deleterious. The second applications concerned an analysis of a cylindrical shell where nonlinear bulge-out is accounted for. The residual strength was compared with corresponding flat sheet results. The stress levels for the shelf are two to three times lower due to bulge out, but the relative reduction due to MSD was very similar.

Author

Residual Strength; Fracture Strength; Mathematical Models; Crack Propagation; Crack Geometry; Computerized Simulation; Aircraft Structures; Structural Analysis

19990028741 Drexel Univ., Dept. of Materials Engineering, Philadelphia, PA USA

Boundary Connection Factors for Elliptical Surface Cracks Emanating from Countersunk Rivet Holes

Rahman, Anisur, Drexel Univ., USA; Bakuckas, John G., Jr., Hughes Technical Center, USA; Bigelow, Catherine A., Hughes Technical Center, USA; Tan, Paul W., Hughes Technical Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 598-609; In English; See also 19990028721

Contract(s)/Grant(s): FAA-97-G-026; MSS960013P; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

To predict crack growth and residual strengths of riveted joints subjected to widespread fatigue damage (WFD), accurate stress and fracture analyses of corner and surface cracks at a rivet hole are needed. The results presented in this paper focus on the computation of stress-intensity factor (SIF) solutions for cracks at countersunk rivet holes for tension, bending, and wedge load conditions. A wide range of configurations was considered varying the crack size, crack shape, crack location, and the height of the straight-shank hole. A global-intermediate-local (GIL) hierarchical approach implementing the finite element method was used in this study. The GIL approach was used to determine the boundary correction factors, a nondimensional representation of the SIF, for a wide range of configurations representing typical countersunk holes in aircraft structural joints. The boundary correction factor was determined along the crack front in terms of the physical angle measured from the inner surface of the plate to the boundary of the countersunk rivet hole. In general, the values of boundary correction factors increased as the location along the crack front moves from the inner surface of the plate towards the hole boundary. For all the crack locations analyzed, the inner surface of the plate has less of an influence on the boundary correction factor than the hole and outer surface boundaries. The values of the boundary correction factor were highest for the crack fronts closest to the hole boundary. The trends in the solutions were the same for the three loading conditions.

Author

Crack Propagation; Holes (Mechanics); Riveted Joints; Stress Intensity Factors; Surface Cracks; Residual Strength; Damage; Aircraft Structures; Boundary Conditions; Crack Geometry; Finite Element Method

19990028742 NASA Langley Research Center, Hampton, VA USA

Stable Tearing and Buckling Responses of Unstiffened Aluminum Shells with Long Cracks

Starnes, James H., Jr., NASA Langley Research Center, USA; Rose, Cheryl A., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 610-626; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The results of an analytical and experimental study of the nonlinear response of thin, unstiffened, aluminum cylindrical shells with a long longitudinal crack are presented. The shells are analyzed with a nonlinear shell analysis code that accurately accounts for global and local structural response phenomena. Results are presented for internal pressure and for axial compression loads. The effect of initial crack length on the initiation of stable crack growth and unstable crack growth in typical shells subjected to internal pressure loads is predicted using geometrically nonlinear elastic-plastic finite element analyses and the crack-tip-opening angle (CTOA) fracture criterion. The results of these analyses and of the experiments indicate that the pressure required to initiate stable crack growth and unstable crack growth in a shell subjected to internal pressure loads decreases as the initial crack length increases. The effects of crack length on the prebuckling, buckling and postbuckling responses of typical shells subjected to axial compression loads are also described. For this loading condition, the crack length was not allowed to increase as the load was increased. The results of the analyses and of the experiments indicate that the initial buckling load and collapse load for a shell subjected to axial compression loads decrease as the initial crack length increases. Initial buckling causes general instability or collapse of a shell for shorter initial crack lengths. Initial buckling is a stable local response mode for longer initial crack lengths. This stable local buckling response is followed by a stable postbuckling response, which is followed by general or overall instability of the shell.

Author

Dynamic Response; Cylindrical Shells; Finite Element Method; Crack Propagation; Crack Tips; Crack Initiation; Applications Programs (Computers); Cracking (Fracturing); Fuselages; Elastic Buckling; Dynamic Models

19990028743 Cornell Univ., Dept. of Theoretical and Applied Mechanics, Ithaca, NY USA

Fracture Mechanics of Thin, Cracked Plates Under Tension, Bending and Out-of-Plane Shear Loading

Zehnder, Alan T., Cornell Univ., USA; Hui, C. Y., Cornell Univ., USA; Potdar, Yogesh, Cornell Univ., USA; Zucchini, Alberto, Energia Nucleare e Delle Energie Alternative, Italy; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 627-634; In English; See also 19990028721

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Cracks in the skin of aircraft fuselages or other shell structures can be subjected to very complex stress states, resulting in mixed-mode fracture conditions. For example, a crack running along a stringer in a pressurized fuselage will be subject to the usual

in-plane tension stresses (Mode-I) along with out-of-plane tearing stresses (Mode-III like). Crack growth and initiation in this case is correlated not only with the tensile or Mode-I stress intensity factor, K(sub I), but depends on a combination of parameters and on the history of crack growth. The stresses at the tip of a crack in a plate or shell are typically described in terms of either the small deflection Kirchhoff plate theory. However, real applications involve large deflections. We show, using the von-Karman theory, that the crack tip stress field derived on the basis of the small deflection theory is still valid for large deflections. We then give examples demonstrating the exact calculation of energy release rates and stress intensity factors for cracked plates loaded to large deflections. The crack tip fields calculated using the plate theories are an approximation to the actual three dimensional fields. Using three dimensional finite element analyses we have explored the relationship between the three dimensional elasticity theory and two dimensional plate theory results. The results show that for out-of-plane shear loading the three dimensional and Kirchhoff theory results coincide at distance greater than h/2 from the crack tip, where h/2 is the plate thickness. Inside this region, the distribution of stresses through the thickness can be very different from the plate theory predictions. We have also explored how the energy release rate varies as a function of crack length to plate thickness using the different theories. This is important in the implementation of fracture prediction methods using finite element analysis. Our experiments show that under certain conditions, during fatigue crack growth, the presence of out-of-plane shear loads induces a great deal of contact and friction on the crack surfaces, dramatically reducing crack growth rate. A series of experiments and a proposed computational approach for accounting for the friction is discussed.

Author

Crack Propagation; Crack Tips; Fracture Mechanics; Fuselages; Plate Theory; Crack Initiation; Bending; Tensile Stress; Shear Stress; Structural Analysis; Surface Cracks

19990028744 Cornell Univ., Fracture Group, Ithaca, NY USA

Residual Strength Prediction of Fuselage Structures with Multiple Site Damage

Chen, Chuin-Shan, Cornell Univ., USA; Wawrzynek, Paul A., Cornell Univ., USA; Ingraffea, Anthony R., Cornell Univ., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 635-656; In English; See also 19990028721

Contract(s)/Grant(s): NAG1-1184; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper summarizes recent results on simulating full-scale pressure tests of wide body, lap-jointed fuselage panels with multiple site damage (MSD). The crack tip opening angle (CTOA) fracture criterion and the FRANC3D/STAGS software program were used to analyze stable crack growth under conditions of general yielding. The link-up of multiple cracks and residual strength of damaged structures were predicted. Elastic-plastic finite element analysis based on the von Mises yield criterion and incremental flow theory with small strain assumption was used. A global-local modeling procedure was employed in the numerical analyses. Stress distributions from the numerical simulations are compared with strain gage measurements. Analysis results show that accurate representation of the load transfer through the rivets is crucial for the model to predict the stress distribution accurately. Predicted crack growth and residual strength are compared with test data. Observed and predicted results both indicate that the occurrence of small MSD cracks substantially reduces the residual strength. Modeling fatigue closure is essential to capture the fracture behavior during the early stable crack growth. Breakage of a tear strap can have a major influence on residual strength prediction.

Author

Residual Strength; Fuselages; Full Scale Tests; Lap Joints; Crack Opening Displacement; Applications Programs (Computers); Stress Distribution; Computerized Simulation; Finite Element Method; Mathematical Models; Fracture Mechanics

19990028745 Computational Mechanics, Inc., Billerica, MA USA

Fatigue Crack Growth Simulation for Complex Three-Dimensional Geometry and Loading

Curtin, Thomas J., Computational Mechanics, Inc., USA; Adey, Robert A., Computational Mechanics, Inc., USA; Baynham, John M. W., Computational Mechanics, Inc., USA; Marais, Philip, Computational Mechanics, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 657-666; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The focus of this paper is on the implementation of the boundary element method to investigate the impact of cracks in aerospace components. The theoretical background of the boundary element based fracture mechanics algorithms is discussed and the capability of the method is illustrated with applications pertinent to the aerospace industry. The methodology and applications discussed in this paper are based on the BEASY Fatigue and Crack Growth software developed by Computational Mechanics Inc. The boundary element method utilized in the software is well suited for simulating fracture and crack propagation. The BEASY

fracture simulation tool can be easily incorporated in damage tolerance programs and serve to provide quantitative data in terms of the impact of fracture related damage.
Author
Boundary Element Method; Fracture Mechanics; Crack Propagation; Fatigue (Materials); Applications Programs (Computers); Computerized Simulation

19990028746 Sikorsky Aircraft, Airframe Structures, Stratford, CT USA
A Comparison of Numerical Methods of Fracture Analysis with Helicopter Structure
Bauer, George V., Sikorsky Aircraft, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 667-678; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This Paper provides the results of an investigation of two numerical methods for calculation of stress intensity and crack growth for through thickness cracks in complex structures. The two numerical methods are the NASTRAN two dimensional crack tip finite element CRAC2D and the Surface Integral and Finite Element (SAFE) hybrid analysis. The basis and applicability of each method is discussed, and comparison is made with standard through thickness crack handbook solutions. The application of these methods to crack growth analysis in a typical helicopter airframe structure is evaluated.
Author
Applications Programs (Computers); Airframes; Crack Propagation; Nastran; Structural Analysis; Fracture Mechanics; Finite Element Method; Mathematical Models

19990028747 Lehigh Univ., Dept. of Mechanical Engineering and Mechanics, Bethlehem, PA USA
Importance of Chemically Short-Crack-Growth on Fatigue Life
Dolley, Evan J., Lehigh Univ., USA; Wei, Robert P., Lehigh Univ., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 679-687; In English; See also 19990028721
Contract(s)/Grant(s): F49620-96-1-0245; F49620-98-1-0198; FAA-92-G-0006; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Commercial and military aircraft are exposed to deleterious environments (such as atmospheric moisture and salt spray) that enhance the fatigue crack-growth (FCG) rates in aircraft structural components. This phenomenon, generically termed corrosion fatigue (CF) must be explicitly taken into account in the development of life prediction and management methodology. CFCG behavior may be separated into two regimes: a chemically long-crack regime and a chemically short-crack regime. Experimental data on aluminum alloys used in aircraft construction show that the CFCG rates are up to 10 times that in an inert environment in the long-crack regime. In the chemically short regime, the growth rates are further enhanced by up to a factor of three, with the effect extending out to crack lengths of up to 6 mm. The accelerated CFCG rates in the short-crack regime must be considered since they can affect crack-growth, for example, over nearly one-half of the inter-rivet distance in typical fuselage lap-splice joints. Crack-growth results on 2024-T3 and 7075-T6 aluminum alloys are presented and compared. The implication of the chemically short-crack-growth regime on fatigue life is discussed.
Author
Crack Propagation; Short Cracks; Aircraft Structures; Aluminum Alloys; Fatigue Life; Structural Analysis

19990028748 Aero Vodochody A.S., Odolena Voda, Czechoslovakia
Composite Coating of Jet Engine Air Intake as a Protection Against Acoustic Fatigue
Fidransky, Jiri, Aero Vodochody A.S., Czechoslovakia; Fiala, Jiri, Aero Vodochody A.S., Czechoslovakia; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 688-696; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The Aero Vodochody L59 advanced jet trainer is powered by DV2 engine with the trust of 4900 lb. A significant damage of air intake was caused by sonic fatigue after a very short time of aircraft prototype testing. Original design of air intake was made as a sheet formed riveted aluminum structure. Initial damage, such as stiffener cracks and broken rivets, occurred after 50 hours of engine run. Acoustic loading was analyzed afterwards and significant load of almost 160 dB was found. Based on previous experience we assumed that existing structure was not able to withstand acoustic pressures of such level, mostly concentrated on frequency of 3 kHz. Having in mind natural fatigue limits of aluminum structures, removable part of air intake was replaced for modified one. Driving force of modification was an idea of durable and easy to change structure, with better damping. Engine inlet part was substituted for stiffer ring, made of high strength steel, cylindrical part of air passage was replaced by carbon fibre monolithic structure of outstanding durability, but bifurcated air duct as a part of the fuselage structure was difficult to change. This part is fully integrated into the fuselage load path and proposed material change to carbon fibre composite structure was not feasible. When structural response of fatigue critical areas was analyzed, existing metallic structure, coated with glass and carbon

fibre composite as all surface doublers has been proposed as the most suitable solution. Main design goals were to lower stresses in existing fuselage structure, to improve structural damping, to reduce stress concentration and to use material with the best available fatigue characteristic. Final design consists of metal sheet with stacked layers of woven glass and carbon fibres in Epoxy matrix. Composite layers were impregnated, bonded to supporting structure and cured in single cycle. Sophisticated stacking up improved stiffness, structural damping and reduced thermal induced stresses between adjacent layers into acceptable level. Hybrid wall structure was designed so as to be tolerant to accidental damage or to interlaminar cracks. Therefore, a very extensive qualification process took place, but major problems, we were faced with concern environmental resistance of composite to metal bonding, resistance to thermal induced stresses and full scale verification of service efficiency. Several hundreds of coupons were tested during qualification process. Final proof of structure was given by in service measurement. The lot production of composite air intake coat required building up a special shop. At the beginning of nineties, about 70 air intakes of L59 aircraft were treated. Total covered surface was about 45 square feet per one aircraft. All aircraft have been in service for about 6 years. There have been no service reported difficulties regarding composite coat of air duct, their wear or damage. The same treatment seems to be effective for any acoustic loaded air passages or heavy loaded open surfaces.
Author
Protective Coatings; Composite Materials; Air Intakes; Acoustic Fatigue; High Strength Steels; Epoxy Matrix Composites; Fiber Composites; Dynamic Structural Analysis

19990028749 Bombardier, Inc., Mirabel, Quebec Canada
CF-18 Inner Wing Front Spar Cracking
Francoeur, Yvan, Bombardier, Inc., Canada; Adam, Daniel, Bombardier, Inc., Canada; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 697-706; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Cracks at various holes on the Canadian CF-18 Inner Wing Front Spar (P/N 74A110604) near the Inboard Leading Edge Flap (ILEF) Drive Hinge were detected. The most cost effective modification for this location involve either coldwork, forcemate or IF bushing. The critical holes are all located in a seal groove therefore the spar can only be reworked on 70% of its thickness. In addition, the holes are separated 1.0 inch apart so residual stresses of the coldwork and forcemate process super-impose at the center of the two holes. In this situation, available fatigue analysis produces highly questionable results. A fatigue coupon test is therefore required. The finite element analysis performed to evaluate the residual stress of each process and define the adequate test specimen geometry is presented. An experimental substantiation of the FE results will follow. Finally a brief discussion of the coupon test is provided.
Author
Cracking (Fracturing); Residual Stress; Structural Members; Aircraft Structures; Structural Analysis; Finite Element Method; Stress Analysis

19990028750 APR Consultants, Inc., Medway, OH USA
Reduction in Fatigue Damage Incurred During Ground Operations on Rough Runways
Gerardi, Tony, APR Consultants, Inc., USA; Tritsch, Doug, Dayton Univ. Research Inst., USA; Knarr, Robert, Knarr (Robert), USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 707-715; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The combination of expanded usage, extended service life, and fiscal constraints has led to a focus on the technologies which support the structural integrity of aging aircraft. The aim is to reduce the support and sustainment burdens of these aging aircraft. This includes safely extending the useful service life of an airframe by reducing the fatigue damage accumulation rates. Reducing the number of damaging events or the magnitude of some damaging events will mitigate the fatigue damage accumulation. The results from this effort offers a concept that involves altering the landing gear service procedures to increase the strut precharge pressure. This non-intrusive technique will significantly reduce the dynamic loads experienced by an aircraft during takeoff. The fatigue life of an aircraft is based in part, on the number and magnitude of ground-air-ground (GAG) cycles the aircraft is expected to experience. Recall that the ”ground” loads define the alternating portion of the GAG cycle. Fatigue crack initiation and growth rates are most influenced by changes in the alternating part of a damaging load cycle. Generally, the design has factored in dynamic loads experienced by the aircraft during takeoff, measured as accelerations at the center of gravity, (load factors). In particular, the negative load factors the overall GAG definition. It is important to recall that aircraft are designed for more positive g’s than negative g’s. However, it is not unusual to exceed 0.5 g on paved runways that have deteriorated with time and use. Consequently, operations on rough runways will reduce the life of the aircraft. The overall objective was to develop a practical method for estimating the extended airframe life by reducing loads due to ground operations on rough runways. The primary purpose was to determine the feasibility of the concept that increasing the landing gear strut precharge pressure is an adequate approach to achieving

a reasonable reduction in the airframe loads. Investigations have shown that ground loads can cause airframe structural damage and is more prevalent than previously suspected. One example was an L-1011 found with a 24- inch long crack in a rear wing spar web at the main landing gear trunnion attachment. The results of this effort included: 1) Establishing that a 30% reduction in the magnitude of the load was achieved by increasing strut precharge pressure; 2) Validation with hydraulic shaker tests; and 3) A preliminary estimated fatigue life factor of 1.15, (15% life extension) achieved by reducing airframe loads due to rough runway ground loads. This poster presentation covers the efforts and results and describes the next step prior to implementation.
Author (revised)
Dynamic Loads; Landing Gear; Struts; Dynamic Pressure; Cumulative Damage; Load Distribution (Forces)

19990028752 Northrop Grumman Corp., El Segundo, CA USA
Composite Patch Repair Applications to T-38 Lower Wing Skin
Helbling, James, Northrop Grumman Corp., USA; Heimerdinger, Maro, Northrop Grumman Corp., USA; Ratwani, Mohan M., R-Tec, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 722-731; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A bonded composite reinforcement concept has been investigated for the T-38 aircraft as a means to retard crack initiation and crack growth occurring in a machined pocket area of the lower wing skin. A test program has been carried out to experimentally determine the crack growth life extension offered by the composite patch reinforcement and verify the patch design and analysis. Test specimens were designed to simulate the pocket area in the wing where cracking is occurring. Two specimens were tested under fighter spectrum loading. One specimen was tested without the reinforcement to obtain baseline crack growth data, and an identical specimen was tested with a 26 ply boron/epoxy patch bonded to one surface. The test specimens were strain gaged to obtain load distributions in the specimen and determine the amount of load transfer to the patch. The crack growth life of the specimen with the patch installed was found to be approximately twice that of the unreinforced specimen. The crack growth data obtained from the tests showed considerably longer crack growth life compared to the analytical predictions. This anomaly was apparently the result of the initial flaw being placed near the corner of the machined pocket, thus causing the crack to be retarded in the direction of increased skin thickness. Adjustments were made to the analytical model which allowed for a good correlation between the predicted crack growth and the test data.
Author
Crack Initiation; Crack Propagation; Skin (Structural Member); Aircraft Structures; Composite Materials

19990028753 College of William and Mary, Dept. of Applied Science, Williamsburg, VA USA
Lamb Wave Tomography for Corrosion Mapping
Hinders, Mark K., College of William and Mary, USA; McKeon, James C. P., College of William and Mary, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 732-740; In English; See also 19990028721; Sponsored in part by the Virginia Space Grant Consortium; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

As the world-wide civil aviation fleet continues to age, methods for accurately predicting the presence of structural flaws-such as hidden corrosion-that compromise airworthiness become increasingly necessary. Ultrasonic guided waves, Lamb waves, allow large sections of aircraft structures to be rapidly inspected. However, extracting quantitative information from Lamb wave data has always involved highly trained personnel with a detailed knowledge of mechanical-waveguide physics. Our work focuses on using a variety of different tomographic reconstruction techniques to graphically represent the Lamb wave data in images that can be easily interpreted by technicians. Because the velocity of Lamb waves depends on thickness, we can convert the travel times of the fundamental Lamb modes into a thickness map of the inspection region. In this paper we show results for the identification of single or multiple back-surface corrosion areas in typical aluminum aircraft skin structures.
Author
Ultrasonic Flaw Detection; Lamb Waves; Corrosion; Detection; Aircraft Structures; Tomography

19990028754 Analytical Services and Materials, Inc., Hampton, VA USA
Experimental Results from the FAA/NASA Wide Panel Fracture Tests
Johnston, William M., Analytical Services and Materials, Inc., USA; Helm, Jeffrey D., South Carolina Univ., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 741-754; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The objective of the FAA/NASA wide panel test program was to determine the influence of multiple-site damage (MSD) on the residual strength of stiffened and unstiffened panels and to develop a body of experimental data that can be used to verify any fracture criterion for structures with MSD cracking. To simulate an aircraft skin, tests were conducted on 40-inch wide panels of 0.063-inch thick 2024-T3 aluminum alloy with stiffeners that were made of 0.090-inch thick 7075-T6 aluminum alloy. The FAA/

NASA wide panel tests were performed on panels with and without riveted stiffeners for five different crack configurations. The riveted stiffened panels were designed to provide a configuration similar to a riveted curved aircraft structure. The crack configurations tested were single crack, single crack growing into a line of open holes, and single crack growing into a line of open holes with MSD cracks. These test configurations simulated a long crack in the presence of a row of holes with and without MSD. Experimental results of the linkup, maximum load, local and global strain fields, deformation field and load crack extension behavior are presented in this paper. The MSD cause a 20% and 30% reduction in strength for the unstiffened and stiffened panels respectively when compared to the center crack case. The MSD size (0.01 to 0.05 inch) did not significantly effect the reduction in strength caused by the MSD.
Author
Residual Strength; Destructive Tests; Cracking (Fracturing); Aircraft Structures; Skin (Structural Member); Crack Propagation; Aluminum Alloys; Structural Analysis

19990028755 Lynntech, Inc., College Station, TX USA
Novel NDE/I Probe for the Detection of Corrosion in Aircraft Metallic Structures Based on Electrochemical Impedance
Kim, Jinseong, Lynntech, Inc., USA; Gonzalez, Anuncia, Lynntech, Inc., USA; Hodko, Dalibor, Lynntech, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 755-763; In English; See also 19990028721
Contract(s)/Grant(s): F49620-95-C-0050; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Lynntech has developed a prototype of a new NDE/I probe for the detection of corrosion in aircraft metallic structures. The NDE/I system is based on electrochemical impedance (EI) measurements. Lynntech's EI prototype probe uses a single characteristic frequency of the ac signal applied between the probe and the structure under testing. At the selected frequency, the impedance signal is highly sensitive to the degree of corrosion of the sample under study. Thus, real time, on-line evaluation of the corrosion process has been easily achieved. The developed NDE/I probe is simple in design, portable, low in cost, and will not require trained personnel to operate. Another advantage of the probe design is that the use of aggressive electrolytes, a problem known in designing EI probes, is eliminated. The NDE/I probe has been fabricated in different sizes (from 2.3 to 182 sq cm), and is capable of detecting: (1) corroded areas as small as 5 x 10(exp -4) sq cm in painted surfaces, and, (2) a damage area/probe size ratio as low as 0.0004%. The probe has been successfully tested to promptly screen large areas of aircraft structures, such as fuselage, including lap joints and rivets.
Author
Nondestructive Tests; Impedance Measurement; Corrosion; Detection; Aircraft Structures; Structural Analysis

19990028756 Liberty Technology, Conshohocken, PA USA
Implementation of Filmless Radiography for Aerospace Applications
Kinsella, Timothy, Liberty Technology, USA; Carlin, Diana, Air Force Research Lab., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 764-773; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Storage phosphor (filmless) imaging technology provides the potential of utilizing all the advantages of digital imaging as well as eliminating the hazardous material issues related to film processing. This paper describes the efforts undertaken by Liberty Technologies, Inc. to evaluate, develop, and implement an effective, affordable, mobile system of filmless radiography. This program is entitled "Filmless Radiography for Aerospace Applications." Initially, the Air Force NDI Program Office conducted a Phase I SBIR project with Liberty Technologies to determine if filmless radiography is technically feasible and economically viable for the inspection of Air Force weapon systems in both the depot and field environments. Liberty's RADView filmless radiography system was evaluated at several bases and confirmed the system's potential. As a result, the Air Force Research Laboratory, Materials and Manufacturing Directorate, Manufacturing Technology Division then funded a program to enhance RADView's sensitivity and enlarge the image format to meet the needs of aircraft inspections. This paper provides a basic discussion of the technology and system operating specifications, and what they mean with reference to image quality, throughput, and overall costs.
Author
Radiography; Imaging Techniques; Image Processing; Nondestructive Tests

19990028757 YXLON International X-Ray G.m.b.H., Hamburg, Germany

3D Visualization of X-Ray Backscatter Images

Niemann, W., YXLON International X-Ray G.m.b.H., Germany; Kosanetzky, J., YXLON International X-Ray G.m.b.H., Germany; Fischer, K. -H., YXLON International X-Ray G.m.b.H., Germany; Siegel, E., YXLON, Inc., USA; Zahorodney, S., YXLON, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 774-781; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

X-ray backscatter imaging has become a well-known technique for inspection of light materials. Due to its capability of measuring and displaying density differences it has found widespread applications in aircraft industry, such as corrosion inspection of aging aircraft. The commercial system ComScan 160 measures a 3D data-set consisting of 500 * 250 voxels in 22 layers. On a monitor, a set of up to 4 individual slices parallel to the surface of the specimen is displayed for visual inspection. Recently, we have developed new software tools which enable the operator to perform many new kinds of visualization. Various different slices (e.g. xy-, xz- and yz-slices) can be displayed, and furthermore, 3D presentations of the full data sets are possible. As an example, the object can be rotated and tilted. Other software functions enable the presentation of data on a homogenous 3D grey level, so local structures such as cracks, voids, corrosion effects etc. are enhanced and easier to find. With these new tools, the operator has many new possibilities to display and analyze defects in aging aircraft. In problematic inspection cases, the tools enable a more reliable decision on the state of the inspection object.

Author

X Ray Imagery; Structural Analysis; Scientific Visualization; Image Processing

19990028758 West Coast Industries, Inc., Seattle, WA USA

Multiple Initial Coldworking with the Split Mandrel System

Leon, Anthony, West Coast Industries, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 782-791; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper describes a new coldworking procedure, Multiple Initial Coldworking, utilizing the split mandrel process. This procedure coldworks the hole initially three times with the same tooling, instead of the usual one time. An analytical and experimental program was developed to determine the feasibility of this innovative procedure. Computer analysis was performed to determine initial coldwork parameters. Static tests conducted on aluminum and titanium sheets analyzed the effect of the new process on various hole quality issues and applications. Fatigue tests compared the overall life enhancement of the new process over the basic process. Multiple Initial Coldworking produces a hole with greater overall hole quality and retained expansion than traditional single pass coldworking methods. Fatigue results indicate that three-passes at lower applied expansion levels produce fatigue results similar to nominal single pass coldworking. Future testing is also discussed.

Author

Cold Working; Holes (Mechanics); Fatigue Tests; Metal Sheets

19990028759 NASA Langley Research Center, Hampton, VA USA

NASGRO 3.0: A Software for Analyzing Aging Aircraft

Mettu, S. R., Lockheed Martin Space Mission Systems and Services, USA; Shivakumar, V., Lockheed Martin Space Mission Systems and Services, USA; Beek, J. M., Lockheed Martin Space Mission Systems and Services, USA; Yeh, F., Lockheed Martin Space Mission Systems and Services, USA; Williams, L. C., Lockheed Martin Space Mission Systems and Services, USA; Forman, R. G., NASA Johnson Space Center, USA; McMahon, J. J., NASA Johnson Space Center, USA; Newman, J. C., Jr., NASA Langley Research Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 792-801; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Structural integrity analysis of aging aircraft is a critical necessity in view of the increasing numbers of such aircraft in general aviation, the airlines and the military. Efforts are in progress by NASA, the FAA and the DoD to focus attention on aging aircraft safety. The present paper describes the NASGRO software which is well-suited for effectively analyzing the behavior of defects that may be found in aging aircraft. The newly revised Version 3.0 has many features specifically implemented to suit the needs of the aircraft community. The fatigue crack growth computer program NASA/FLAGRO 2.0 was originally developed to analyze space hardware such as the Space Shuttle, the International Space Station and the associated payloads. Due to popular demand, the software was enhanced to suit the needs of the aircraft industry. Major improvements in Version 3.0 are the incorporation of the ability to read aircraft spectra of unlimited size, generation of common aircraft fatigue load blocks, and the incorporation of crack-growth models which include load-interaction effects such as retardation due to overloads and acceleration due to underloads. Five new crack-growth models, viz., generalized Willenborg, modified generalized Willenborg, constant closure model, Walker-Chang model and the deKoning-Newman strip-yield model, have been implemented. to facilitate easier input of geometry, material properties and load spectra, a Windows-style graphical user interface has been developed. Features to quickly change

the input and rerun the problem as well as examine the output are incorporated. NASGRO has been organized into three modules, the crack-growth module being the primary one. The other two modules are the boundary element module and the material properties module. The boundary-element module provides the ability to model and analyze complex two-dimensional problems to obtain stresses and stress-intensity factors. The material properties module allows users to store and curve-fit fatigue-crack growth data. On-line help and documentation are provided for each of the modules. In addition to the popular PC windows version, a unix-based X-windows version of NASGRO is also available. A portable C++ class library called WxWindows was used to facilitate cross-platform availability of the software.
Author
Aircraft Structures; Applications Programs (Computers); Structural Analysis

19990028760 Portsmouth Univ., Portsmouth, UK
Automatic Analysis of Data Derived from Scanning Acoustic/Laser Doppler Velocimeter
Mew, Jackie, Portsmouth Univ., UK; Topp, Robert G., Portsmouth Univ., UK; Webster, John M., Holographics, Inc., USA; Thevar, Thangeval, Holographics, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 802-810; In English; See also 19990028721
Contract(s)/Grant(s): DAAH01-95-C-R182; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Large quantities of data are collected from a non-contacting acoustic/Doppler system that has been developed to non destructively inspect composite materials. It is time-consuming, exhausting and error-prone for a person to sit at a computer screen and physically browse up to 2048 detailed images that are produced from the data. Amongst those images only a small number contain useful information; the majority can be discarded. The useful images are easy to miss if the operator loses concentration, but vital as they may contain information about a fault. Computers process large quantities of information accurately without losing concentration or becoming fatigued. Expert evaluation of data derived from non-destructively inspecting composite samples such as those found on aircraft, ceramics, or metal structures such as helicopter blades, has led to the identification of rules, which in turn has led to the development of a prototype algorithm that automatically detects pertinent data and presents the shape of a fault as a two dimensional image. This paper reports on the results of tests on this prototype software, presenting the rules and applying them specifically to the identification of faults in composite structures. It concludes with a discussion of the next stage, which is the development of software to address issues raised from these experiments.
Author
Nondestructive Tests; Laser Doppler Velocimeters; Aircraft Structures; Fault Detection; Structural Analysis

19990028766 Mercer Univ., Mercer Engineering Research Center, Macon, GA USA
Program for Probabilistic Stress Spectra Generation (ProSpectra)
Schleider, Mary W., Mercer Univ., USA; Babb, Robert A., Mercer Univ., USA; Jansen, Randy, Warner Robins Air Logistics Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 863-871; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

ProSpectra is a Windows-based PC program for developing probabilistic stress spectra for use in crack growth and fatigue analysis. ProSpectra incorporates a simulation methodology whereby the user defines pertinent variables, the relationships between them, and a sequence of events representing specific missions. This program processes discrete stress events, constant amplitude cyclic stresses, and power spectral density stress data to produce a stress spectrum. ProSpectra is a highly flexible tool which allows the definition of nonstandard missions, including those based on a non-certain probability of occurrence.
Author
Structural Analysis; Applications Programs (Computers); Crack Propagation; Spectrum Analysis; Stress Analysis; Fatigue (Materials); Computerized Simulation

19990028768 New South Wales Univ., School of Aerospace and Mechanical Engineering, Canberra, Australia
Modelling of Weak Bonds in Adhesively Fastened Joints
Shankar, Krishnakumar, New South Wales Univ., Australia; Fei, Dong, New South Wales Univ., Australia; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 875-884; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A new conceptual model for the analysis of peel behaviour of weakly bonded adhesive joints is presented in this paper. The paper focuses on modelling weakness in adhesion caused by deterioration of the adhesive bondline, as opposed to weakness in cohesion. For the purposes of analysis the bondline interface in a perfectly bonded adhesive joint is assumed to have the same material properties as the adhesive material, and modelled as such. The degradation of the bondline interface in a weak joint is modelled by considering reduced properties for the bondline interface. Finite element analysis of bonded doubler joints and double

lap joints are carried out to study the peel deformation on the surface of the outer adherends. It is shown that when a doubler or a double lap joint has a good bond on one side and weak one on the other, the reduction in the strength of the bondline on the weak side causes an unsymmetric distribution of the load transferred by the outer adherends, resulting in bending. The bending deformation accentuates the peel deformation on one side while diminishing that on the other, resulting in a considerable difference in the distribution of out of plane displacements on the two sides. Measurement of the differences in the distribution of out of plane displacements using sensitive optical methods such as holographic interferometry enables the detection of weak adhesive bonds by non-destructive inspection.
Author
Bonded Joints; Lap Joints; Aircraft Structures; Structural Analysis; Bending; Load Distribution (Forces); Nondestructive Tests; Peeling

19990028769 SRI International Corp., Menlo Park, CA USA
Methods for Relating Fracture Surface Topography to Load Spectra
Shockey, Donald A., SRI International Corp., USA; Kobayashi, Takao, SRI International Corp., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 885-902; In English; See also 19990028721
Contract(s)/Grant(s): FAA-93-G-065; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A key objective in performing failure analysis of aircraft components subjected to cyclic loads is to determine the load spectra that produced the fracture. SRI International is developing methods to extract this information from the fracture surfaces. One method, fracture surface topography analysis (FRASTA), characterizes the topography of conjugate fracture surfaces with a confocal optics scanning laser microscope, inverts and superimposes one topograph over the other, compares the conjugate topographies with an aid of a computer, and reconstructs the details of the fracture process. A key result is the relationship of the fractured area increase rate with conjugate surface spacing. The increment of conjugate surface spacing increase measured from a base linear line is a parameter representing the inelastic deformation that occurred at the crack tip and thus may be useful in assessing the load spectrum that operated at a specific location on the fracture surface. Another method is to consider the fracture surface profile as a wave composed of different wavelengths and determine the weighting of the component waves by applying fast Fourier transform algorithms. The resulting elevation power spectrum density curves appear to reflect the sequence of load spectrum changes and, thus, can be used to evaluate the load spectra. A third method is to obtain the characteristics of specific fracture surface features using wavelet analysis. The density of dimples, for example, may reflect load magnitudes and we are experimenting to determine if wavelets can identify where changes in load spectrum occurred and if the surface produced by a specific load spectrum has a unique signature. The results obtained by applying these methods to aluminum alloy specimens fractured under several fatigue conditions are presented.
Author
Topography; Structural Analysis; Failure Analysis; Spectrum Analysis; Wavelet Analysis; Fourier Transformation; Cracking (Fracturing); Cyclic Loads

19990028770 Raytheon Systems Co., E-Systems, Waco, TX USA
Aircraft Corrosion Inspection and Evaluation Technique Using Scanning Ultrasonic Methods
Sivam, T. P., Raytheon Systems Co., USA; Ochoa, Carl M., Vista Engineering Services, Inc., USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 903-921; In English; See also 19990028721; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The present work is based upon the collection and evaluation of scanned ultrasonic data from corroded coupon test specimens. The ultimate purpose is to support an approach for a rating scale that can be used to monitor and evaluate quantitatively the effect of detected corrosion in aircraft upon service life for safety evaluation and for the planning of maintenance. Even though the results are preliminary, they indicate the utility of the methodology for aircraft maintenance purposes for some structural materials. For the present effort, representative structural thickness (.063 in.) of 2024 T3 aluminum coupons were corroded by exposure to sea salt water immersion as a simulation of aircraft skin corrosion. These coupons were subsequently examined using scanning ultrasonics and used to identify correlations between the corrosion mass loss and the residual strength and cyclic fatigue life of the coupons. The results indicate that for the corrosion mechanisms considered, it is likely that an accurate and useful field assessment of corrosion may be made at the aircraft maintenance facility level, and that a rating scale is a realistic approach. The rating scale can be used in conjunction with ultrasound data collected from an aircraft and design and service history information to make projections of maintenance intervals and useful service life. Future efforts will address other structural materials such as 7075 T6

aluminum, and will focus upon quantifying intergranular effects in terms of their detection and their contribution to the structural degradation process during corrosion.
Author
Aircraft Maintenance; Aluminum Alloys; Corrosion; Service Life; Aircraft Structures; Ultrasonic Tests; Structural Analysis

19990028771 Northrop Grumman Corp., Hawthorne, CA USA
Aircraft Structural Integrity Monitoring System Development: Review of the Air Force/Navy Smart Metallic Structures Program
VanWay, Craig B., Northrop Grumman Corp., USA; Kudva, Jay N., Northrop Grumman Corp., USA; West, Mark N., Mission Research Corp., USA; Ziola, Steve M., Digital Wave Corp., USA; May, V. Scott, Air Force Research Lab., USA; Zeigler, Michael N., Air Force Research Lab., USA; Alper, James M., Naval Air Warfare Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 922-931; In English; See also 19990028721; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Structural health monitoring (SHM) technologies, the concept of populating an airframe with an array of sensors for damage detection and loads monitoring, have the potential to revolutionize current methods of aircraft tracking. An automated health monitoring system capable of remote damage detection and comprehensive usage monitoring can significantly add to the established success of the US Air Force's aircraft structural integrity program (ASIP), and corresponding US Navy NASIP. Recent advances in sensing systems and data processing hardware have made it possible to greatly expand the type and amount of information used to assess the status of a structure. The objective of one recent investigation into structural health monitoring technologies, the joint Air Force/Navy Smart Metallic Structures (SMS) program, conducted by the Northrop Grumman Corporation, was to demonstrate a prototyped structural health monitoring system incorporating crack growth detection, strain recording, and integrity assessment. The recently concluded final test of this program, a full-scale fatigue test of a wing carry through bulkhead from a modern fighter aircraft, was conducted at the Air Force Research Laboratory, Wright Patterson Air Force Base (WPAFB) during April and May of 1997, and was successful in detecting fatigue crack growth and recording strain history in the bulkhead for the duration of the test. Eighteen acoustic emission sensors and twelve fiber optic strain sensors were distributed in five fatigue critical zones on the test article for health monitoring. Fatigue crack acoustic emissions were detected from a series of crack intitiations that eventually led to the catastrophic failure of the bulkhead on one of the critical zones. This paper will first present an overview of ASIP and its relationship to structural health monitoring (SHM), followed by a brief review of SHM requirements. The bulk of the paper consists of a review of the SMS program focusing on the health monitoring system architecture (specifically the sensors, processors, and analysis algorithms contained therein), the testing performed under the program, and the lessons learned. Health monitoring implementation payoffs are briefly discussed, and finally, conclusions and a preview of future programs are given.
Author
Systems Health Monitoring; Structural Failure; Structural Analysis; Fault Detection; Aircraft Structures; Sensors; Acoustic Emission; Fiber Optics

19990028844 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Development of a general purpose code to couple experimental modal analysis and damage identification algorithms
Doebling, S. W., Department of Energy, USA; Farrar, C. R., Department of Energy, USA; Cornwell, P. J., Department of Energy, USA; Mar. 31, 1998; 10p; In English; Structural Engineers World Congress, USA
Report No.(s): DE98-005067; LA-UR-97-4409; CONF-980711; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper introduces a new toolbox of graphical interface software algorithms for the numerical simulation of vibration tests, analysis of modal data, finite element model correlation, and the comparison of both linear and nonlinear damage identification techniques. This toolbox is unique because it contains several different vibration-based damage identification algorithms, categorized as those which use only measured response and sensor location information (non-model-based techniques) and those which use finite element model correlation (model-based techniques). Another unique feature of this toolbox is the wide range of algorithms for experimental modal analysis. The toolbox also contains a unique capability that utilizes the measured coherence functions and Monte Carlo analysis to perform statistical uncertainty analysis on the modal parameters and damage identification results.
NTIS
Computer Graphics; Algorithms; Mathematical Models; Damage; Numerical Analysis; Vibration Tests; Computer Systems Programs

19990031835 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Study of shock mitigating materials in a split Hopkinson bar configuration, Phase 1

Bateman, V. I., Department of Energy, USA; Brown, F. A., Department of Energy, USA; Hansen, N. R., Department of Energy, USA; Jun. 30, 1998; 163p; In English

Report No.(s): DE98-003521; SAND-96-1437; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sandia National Laboratories (SNL) designs mechanical systems with electronics that must survive high shock environments. These mechanical systems include penetrators that must survive soil, rock, and ice penetration, nuclear transportation casks that must survive transportation environments, and laydown weapons that must survive delivery impact of 125 fps. These mechanical systems contain electronics that may operate during and after the high shock environment and that must be protected from the high shock environments. A study has been started to improve the packaging techniques for the advanced electronics utilized in these mechanical systems because current packaging techniques are inadequate for these more sensitive electronics. In many cases, it has been found that the packaging techniques currently used not only do not mitigate the shock environment but actually amplify the shock environment. An ambitious goal for this packaging study is to avoid amplification and possibly attenuate the shock environment before it reaches the electronics contained in the various mechanical systems. As part of the investigation of packaging techniques, a two phase study of shock mitigating materials is being conducted. The purpose of the first phase reported here is to examine the performance of a joint that consists of shock mitigating material sandwiched in between steel and to compare the performance of the shock mitigating materials. A split Hopkinson bar experimental configuration simulates this joint and has been used to study the shock mitigating characteristics of seventeen, unconfined materials. The nominal input for these tests is an incident compressive wave with 50 fps peak (1,500 (micro)(var-epsilon) peak) amplitude and a 100 (micro)s duration (measured at 10% amplitude).

NTIS

Composite Materials; Bars; Mechanical Shock

19990031966 North Carolina Agricultural and Technical State Univ., Center for Composite Materials Research, Greensboro, NC USA

Three-Dimensional Geometric Nonlinear Contact Stress Analysis of Riveted Joints ***Final Report, 18 Sep. 1995 - 30 Sep. 1998***

Shivakumar, Kunigal N., North Carolina Agricultural and Technical State Univ., USA; Ramanujapuram, Vivek, North Carolina Agricultural and Technical State Univ., USA; 1998; 125p; In English

Contract(s)/Grant(s): NAG1-1754; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The problems associated with fatigue were brought into the forefront of research by the explosive decompression and structural failure of the Aloha Airlines Flight 243 in 1988. The structural failure of this airplane has been attributed to debonding and multiple cracking along the longitudinal lap splice riveted joint in the fuselage. This crash created what may be termed as a minor ”Structural Integrity Revolution” in the commercial transport industry. Major steps have been taken by the manufacturers, operators and authorities to improve the structural airworthiness of the aging fleet of airplanes. Notwithstanding, this considerable effort there are still outstanding issues and concerns related to the formulation of Widespread Fatigue Damage which is believed to have been a contributing factor in the probable cause of the Aloha accident. The lesson from this accident was that Multiple-Site Damage (MSD) in ”aging” aircraft can lead to extensive aircraft damage. A strong candidate in which MSD is highly probable to occur is the riveted lap joint.

Author

Stress Analysis; Riveted Joints; Debonding (Materials); Fatigue (Materials); Structural Failure; Explosive Decompression

19990032036 NASA Glenn Research Center, Cleveland, OH USA

Micromechanics Analysis Code With Generalized Method of Cells (MAC/GMC): User Guide, Version 3

Arnold, S. M., NASA Glenn Research Center, USA; Bednarcyk, B. A., Ohio Aerospace Inst., USA; Wilt, T. E., Akron Univ., USA; Trowbridge, D., Akron Univ., USA; March 1999; 230p; In English

Contract(s)/Grant(s): RTOP 505-23-2L

Report No.(s): NASA/TM-1999-209070; NAS 1.15:209070; E-11626; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The ability to accurately predict the thermomechanical deformation response of advanced composite materials continues to play an important role in the development of these strategic materials. Analytical models that predict the effective behavior of composites are used not only by engineers performing structural analysis of large-scale composite components but also by material scientists in developing new material systems. For an analytical model to fulfill these two distinct functions it must be based on a micromechanics approach which utilizes physically based deformation and life constitutive models and allows one to gener-

ate the average (macro) response of a composite material given the properties of the individual constituents and their geometric arrangement. Here the user guide for the recently developed, computationally efficient and comprehensive micromechanics analysis code, MAC, who's predictive capability rests entirely upon the fully analytical generalized method of cells, GMC, micromechanics model is described. MAC/ GMC is a versatile form of research software that "drives" the double or triply periodic micromechanics constitutive models based upon GMC. MAC/GMC enhances the basic capabilities of GMC by providing a modular framework wherein 1) various thermal, mechanical (stress or strain control) and thermomechanical load histories can be imposed, 2) different integration algorithms may be selected, 3) a variety of material constitutive models (both deformation and life) may be utilized and/or implemented, and 4) a variety of fiber architectures (both unidirectional, laminate and woven) may be easily accessed through their corresponding representative volume elements contained within the supplied library of RVEs or input directly by the user, and 5) graphical post processing of the macro and/or micro field quantities is made available.
Author
Micromechanics; Deformation; Mathematical Models; Prediction Analysis Techniques; Stress-Strain Relationships; Structural Analysis; Thermal Stresses; Composite Materials; Computer Programs

19990032056 Department of Energy, Washington, DC USA
Investigation of time efficiency in wavelet-based Markov parameter extraction methods
Robertson, A. N., Department of Energy, USA; Park, K. C., Department of Energy, USA; Dec. 31, 1998; 7p; In English; 39th; Structures, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): DE98-003465; LA-UR-98-480; CONF-980419; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper investigates the time efficiency of using a wavelet transform-based method to extract the impulse response characteristics of a structural dynamic system. Traditional time domain procedures utilize the measured disturbances and response histories of a system to develop a set of auto and cross correlation functions. Through deconvolution of these functions, or matrix inversion, the Markov parameters of the system may be found. By transforming these functions into a wavelet basis, the size of the problem to be solved can be reduced as well as the computation time decreased. Fourier transforms are also used in this capacity as they may increase the time efficiency even more, but at the cost of accuracy. This paper will therefore compare the time requirements associated with a time, wavelet, and Fourier-based method of Markov parameter extraction, as well as their relative accuracy in modeling the system.
NTIS
Wavelet Analysis; Extraction; Time; Markov Processes

19990032090 NASA Marshall Space Flight Center, Huntsville, AL USA
Measurement of Plastic Stress and Strain for Analytical Method Verification (MSFC Center Director's Discretionary Fund Project No. 93-08) ***Final Report***
Price, J. M., NASA Marshall Space Flight Center, USA; Steeve, B. E., NASA Marshall Space Flight Center, USA; Swanson, G. R., NASA Marshall Space Flight Center, USA; February 1999; 16p; In English
Report No.(s): NASA/TM-1999-209147; NAS 1.15:209147; M-914; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The analytical prediction of stress, strain, and fatigue life at locations experiencing local plasticity is full of uncertainties. Much of this uncertainty arises from the material models and their use in the numerical techniques used to solve plasticity problems. Experimental measurements of actual plastic strains would allow the validity of these models and solutions to be tested. This memorandum describes how experimental plastic residual strain measurements were used to verify the results of a thermally induced plastic fatigue failure analysis of a space shuttle main engine fuel pump component.
Author
Plastic Properties; Space Shuttle Main Engine; Stress-Strain Relationships; Temperature Effects; Failure Analysis; Fuel Pumps

19990032098 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Elastic-plastic failure analysis of pressure burst tests of thin toroidal shells
Jones, D. P., Department of Energy, USA; Holliday, J. E., Department of Energy, USA; Larson, L. D., Department of Energy, USA; Jul. 31, 1998; 14p; In English; Joint Pressure Vessel and Piping (PVP), 1998, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004956; WAPD-T-3123; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper provides a comparison between test and analysis results for bursting of thin toroidal shells. Testing was done by pressurizing two toroidal shells until failure by bursting. An analytical criterion for bursting is developed based on good agreement

between structural instability predicted by large strain-large displacement elastic-plastic finite element analysis and observed burst pressure obtained from test. The failures were characterized by loss of local stability of the membrane section of the shells consistent with the predictions from the finite element analysis. Good agreement between measured and predicted burst pressure suggests that incipient structural instability as calculated by an elastic-plastic finite element analysis is a reasonable way to calculate the bursting pressure of thin membrane structures.
NTIS
Pressure Vessels; Toroidal Shells; Burst Tests; Failure Analysis; Elastic Properties; Plastic Properties

19990032163 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Residual stresses in weld deposited clad pressure vessels and nozzles
Jones, D. P., Department of Energy, USA; Mabe, W. R., Department of Energy, USA; Shadley, J. R., Department of Energy, USA; Rybicki, E. F., Department of Energy, USA; Apr. 30, 1998; 16p; In English
Report No.(s): DE98-004959; WAPD-T-3181; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Results of through-thickness residual stress measurements are provided for a variety of samples of weld deposited 308/309L stainless steel and Alloy 600 cladding on low-alloy pressure vessel ferritic steels. Clad thicknesses between 5 and 9 mm on samples that vary in thickness from 45 to 200 mm were studied. The samples were taken from flat plates, from a spherical head of a pressure vessel, from a ring-segment of a nozzle bore, and from the transition radius between a nozzle and a pressure vessel shell. A layer removal method was used to measure the residual stresses. The effects of uncertainties in elastic constants (Young's modulus and Poisson's ratio) as well as experimental error are assessed. All measurements were done at room temperature. The results of this work indicate that curvature plays a significant role in cladding residual stress and that tensile residual stresses as high as the yield stress can be measured in the cladding material. Since the vessel from which the spherical and nozzle corner samples were taken was hydrotested, and the flat plate specimens were taken from specimens used in mechanical fatigue testing, these results suggest that rather high tensile residual stresses can be retained in the cladding material even after some mechanical loading associated with hydrotesting and that higher levels of hydrotest loading would be required to alter the cladding residual stresses.
NTIS
Pressure Vessels; Welding; Deposition; Cladding; Mechanical Measurement; Residual Stress; Stress Measurement

19990032164 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Fatigue crack growth testing of sub-clad defects
Jones, D. P., Department of Energy, USA; Leax, T. R., Department of Energy, USA; Apr. 30, 1998; 18p; In English
Report No.(s): DE98-004958; WAPD-T-3124; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fatigue crack growth tests were performed on four point bend specimens with crack like defects intentionally placed in A302B low-alloy pressure vessel steel clad with 308/309L weld deposited stainless steel. The defects were placed in the base metal under the cladding by machining a cavity from the side opposite the cladding, electric-discharge machining a very sharp flaw, fatigue pre-cracking the flaw, and then filling up the cavity by a weld repair process. The specimens were stress relieved before fatigue testing. The specimens were fatigue cycled at positive load ratios until the defects broke through to the surface. The specimens were then fractured at liquid nitrogen temperatures to reveal the fracture surfaces. Seven different sub-clad flaw specimens were tested in room temperature air and each test provides a record of cycles to defect break-through. Changes in defect size and shape as a function of applied load cycles were obtained by benchmarking the crack at various stages of the load history. The results provide a set of embedded defect data which can be used for qualifying fatigue crack growth analysis procedures such as those in Section XI of the ASME Boiler and Pressure Vessel Code. A comparison between calculated and measured values shows that the ASME B and PV Section XI fatigue crack growth procedures conservatively predict cycles to defect break-through for small sub-clad defects.
NTIS
Steels; Pressure Vessels; Crack Propagation; Fatigue (Materials); Fatigue Tests

19990032165 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Application of equivalent elastic methods in three-dimensional finite element structural analysis
Jones, D. P., Department of Energy, USA; Gordon, J. L., Department of Energy, USA; Hutula, D. N., Department of Energy, USA; Holliday, J. E., Department of Energy, USA; Jandrasits, W. G., Department of Energy, USA; Feb. 28, 1998; 16p; In English; Joint Pressure Vessel and Piping (PVP), 1998, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004957; WAPD-T-3125; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes use of equivalent solid (EQS) modeling to obtain efficient solutions to perforated material problems using three-dimensional finite element analysis (3D-FEA) programs. It is shown that the accuracy of EQS methods in 3D-FEA

depends on providing sufficient equivalent elastic properties to allow the EQS material to respond according to the elastic symmetry of the pattern. Peak stresses and ligament stresses are calculated from the EQS stresses by an appropriate 3D-FEA submodel approach. The method is demonstrated on the problem of a transversely pressurized simply supported plate with a central divider lane separating two perforated regions with circular penetrations arranged in a square pattern. A 3D-FEA solution for a model that incorporates each penetration explicitly is used for comparison with results from an EQS solution for the plate. Results for deflection and stresses from the EQS solution are within 3% of results from the explicit 3D-FE model. A solution to the sample problem is also provided using the procedures in the ASME B and PV Code. The ASME B and PV Code formulas for plate deflection were shown to overestimate the stiffening effects of the divider lane and the outer stiffening ring.
NTIS
Pressure Vessels; Stress Analysis; Finite Element Method; Structural Analysis; Three Dimensional Models

19990032182 Akron Univ., Dept. of Civil Engineering, Akron, OH USA
Analysis of an Interface Crack for a Functionally Graded Strip Sandwiched between Two Homogeneous Layers of Finite Thickness *Final Report*
Shbeeh, N. I., Akron Univ., USA; Binienda, W. K., Akron Univ., USA; February 1999; 36p; In English
Contract(s)/Grant(s): NAS3--2201; RTOP 537-04-22
Report No.(s): NASA/CR-1999-208874; NAS 1.26:208874; E-11532; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The interface crack problem for a composite layer that consists of a homogeneous substrate, coating and a non-homogeneous interface was formulated for singular integral equations with Cauchy kernels and integrated using the Lobatto-Chebyshev collocation technique. Mixed-mode Stress Intensity Factors and Strain Energy Release Rates were calculated. The Stress Intensity Factors were compared for accuracy with relevant results previously published. The parametric studies were conducted for the various thickness of each layer and for various non-homogeneity ratios. Particular application to the Zirconia thermal barrier on steel substrate is demonstrated.
Author
Cracks; Homogeneity; Singular Integral Equations; Cauchy Problem; Chebyshev Approximation; Stress Intensity Factors

19990032185 Akron Univ., Dept. of Civil Engineering, Akron, OH USA
Analysis of Multiple Cracks in an Infinite Functionally Graded Plate *Final Report*
Shbeeb, N. I., Akron Univ., USA; Binienda, W. K., Akron Univ., USA; Kreider, K. L., Akron Univ., USA; February 1999; 52p; In English
Contract(s)/Grant(s): NAG3-2201; RTOP 537-04-22
Report No.(s): NASA/CR-1999-208676; NAS 1.26:208676; E-11406; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A general methodology was constructed to develop the fundamental solution for a crack embedded in an infinite non-homogeneous material in which the shear modulus varies exponentially with the y coordinate. The fundamental solution was used to generate a solution to fully interactive multiple crack problems for stress intensity factors and strain energy release rates. Parametric studies were conducted for two crack configurations. The model displayed sensitivity to crack distance, relative angular orientation, and to the coefficient of nonhomogeneity.
Author
Cracks; Embedding; Inhomogeneity; Strain Energy Release Rate; Stress Intensity Factors; Cartesian Coordinates

19990032253 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Residual stresses due to processing of composite tubes
Wang, X. L., Department of Energy, USA; Hubbard, C. R., Department of Energy, USA; Spooner, S., Department of Energy, USA; Taljat, B., Department of Energy, USA; Keiser, J. R., Department of Energy, USA; Feb. 05, 1998; 8p; In English; 5th; Residual stresses, USA
Report No.(s): DE98-005045; ORNL/CP-96816; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

X-ray and neutron diffraction were used to characterize residual stresses in composite tubing of a corrosion-resistant clad alloy on carbon steel. A useful X-ray method, based on the measurement of the fcc (3 1 1) reflection using Cr K(sub (beta)) radiation, was developed which allowed precise determination of surface residual stresses in the textured clad layer. Neutron diffraction measurements were carried out in both the carbon steel core and the clad layer, using the bcc (2 1 1) and fcc (3 1 1) reflections, respectively. The neutron diffraction results are consistent with surface residual stresses determined with X-ray diffraction. However, the through-thickness stress profiles established by X-ray and neutron diffraction do not agree with elastic calculations based

on the thermal expansion mismatch between the carbon steel and clad alloy. The differences between the calculation and experimental results are discussed.
NTIS
Residual Stress; Composite Structures; Pipes (Tubes); Carbon Steels

19990032383 Department of Defense, Washington, DC USA
Boundary conditions in a meshless staggered particle code
Libersky, L. D., Department of Defense, USA; Randles, P. W., Department of Defense, USA; Dec. 31, 1998; 10p; In English; 4th; Computational Mechanics, USA
Report No.(s): DE98-003452; LA-UR-98-590; CONF-980639; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A meshless method utilizing two sets of particles and generalized boundary conditions is introduced. Companion sets of particles, one carrying velocity and the other carrying stress, are employed to reduce the undesirable effects of collocation of all field variables and increase accuracy. Boundary conditions implemented within this staggered framework include contact, stress-free, stress, velocity, and symmetry constraints. Several test problems are used to evaluate the method. of particular importance is the motion of stress particles relative to velocity particles in higher dimensions. Early results show promise, but difficulties remain that must be overcome if the staggered technique is to be successful.
NTIS
Boundary Conditions; Staggering; Particles

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GEOSCIENCES (GENERAL)

19990028569 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
The ASGAMAGE Workshop
Oost, Wiebe A., Editor, Royal Netherlands Meteorological Inst., Netherlands; 1998; ISSN 0169-1651; In English, 22-25 Sep. 1997, De Bilt, Netherlands; See also 19990028570 through 19990028581
Report No.(s): KNMI-WR-98-02; ISBN 90-369-2135-X; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The preliminary results of the ASGAMAGE study are presented. The objectives ASGAMAGE phase A and Phase B studies are: (1) to find relationships between the transport coefficients for the gas fluxes and any relevant geophysical parameters; (2) to compare different methods and systems to measure the transfer velocity of trace gases over the sea; (3) to find out whether and if at all, under what conditions there can be a significant vertical change in the carbon dioxide concentration in the upper meters of the water column; (4) To test new methods and new equipment for the measurement of air-sea fluxes of CO2, N2O, and CH4. The ongoing publications of the findings in refereed journals is also reviewed.
CASI
Air Water Interactions; Carbon Dioxide; Carbon Dioxide Concentration; Nitrogen Oxides; Transport Properties; Conferences

19990028570 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
KNMI Analyses of ASGAMAGE Data and Results: Status September 1997
Jacobs, Cor, Royal Netherlands Meteorological Inst., Netherlands; Kohsiek, Wim, Royal Netherlands Meteorological Inst., Netherlands; Oost, Wiebe, Royal Netherlands Meteorological Inst., Netherlands; vanOort, Cor, Royal Netherlands Meteorological Inst., Netherlands; Wallbrink, Hendrik, Royal Netherlands Meteorological Inst., Netherlands; Worrell, Ed, Royal Netherlands Meteorological Inst., Netherlands; The ASGAMAGE Workshop; 1998, pp. 20-32; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The analyses of ASGAMAGE data performed so far at KNMI concentrated on the direct determination of the air to sea transfer velocity of CO2, k(sub CO2). Furthermore, some attention was paid to the bulk transfer coefficients for the transport of latent and sensible heat, C(sub EN) and C(sub HN), respectively. The direct determination of k(sub CO2) used the fact that this parameter is defined by: F(sub CO2) = K(sub CO2) D[CO2], where F(sub CO2) is the CO2, flux D[CO2] is the difference between the CO2 concentration in the water, C(sub W) and the equilibrium concentration, C(sub eq). The later concentration is defined by C(eq) = C(sub a)/K(sub H) with C(sub a) the CO2 concentration in the air and K(sub H) is the dimensionless Henry coefficient. This coefficient depends mainly on the solubility of the gas under consideration and is a function of temperature, T, and Salinity, S.

For CO2 its value is about 1 at T= 12C, and S=31 0/00. During ASGAMAGE, all components needed to compute K(sub CO2) from F(sub CO2), C(sub W), C(sub a), T and S) were observed. Results are discussed, and results for C(sub EN) and C(sub HN) are given.
Author
Carbon Dioxide Concentration; Salinity; Water; Heat Transfer; Air Water Interactions

19990028655 Forest Service, Rocky Mountain Research Station, Ogden, UT USA
Alkalinity Generation in Snowmelt and Rain Runoff during Short Distance Flow over Rock
Clayton, J. L., Forest Service, USA; Oct. 1998; 16p; In English
Report No.(s): PB99-113839; RMRS-RP-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

High-elevation ecosystems in the western USA typically have patchy, discontinuous areas of surficial soils surrounded by large areas of rock outcrop, talus, and scree. Snowmelt and precipitation that percolate through soil increase in alkalinity, principally by increasing base cation concentration through cation exchange, and by decreasing acid anion concentration by adsorption or uptake of sulfate and nitrate. In the Wind River Mountains, WY, snowmelt and rain samples increased in alkalinity approximately 35 meq L-1 during 15 to 50 meter transport over rock, lichens, and thin pockets of saprolite and soil. Alkalinity increases were principally due to increased base cation concentration. Nitrate concentrations in snow melt decreased from approximately 8 meg/l to meq/l; however, nitrate increased following rock transport of rainfall.
NTIS
Alkalinity; Ecosystems; Snow; Adsorption; Soils

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EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see 35 Instrumentation and Photography.

19990028342 Department of Energy, Washington, DC USA
Measurements of slant and vertical TEC using data from FORTE and the TRACKER ray-tracing code
Massey, R. S., Department of Energy, USA; Dec. 12, 1997; 10p; In English, USA
Report No.(s): DE98-004325; LA-UR-97-5144; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In a previous informal report, the author described the FORTE satellite and the analysis techniques used to extract a slant Total Electron Content (TEC) from measurements of the dispersion of a signal transmitted from and EMP generator at Los Alamos. In this report he reports on the use of a ray-tracing/ionospheric model code to deduce the vertical TEC to 800 km from the FORTE measurements.
NTIS
Slopes; Ray Tracing; Electron Density (Concentration); Artificial Satellites

19990028393 Department of Energy, Washington, DC USA
Informal report on measurements of slant TEC by FORTE
Massey, R. S., Department of Energy, USA; Nov. 21, 1997; 10p; In English, USA
Report No.(s): DE98-004324; LA-UR-97-4852; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Los Alamos National Laboratory's Space and Atmospheric Sciences group is now operating the FORTE satellite, which has two sets of instruments: optical detectors and radio detectors. In this report the author describes work with one set of radio detectors that allow measurements of the total electron content (TEC) traversed by Very High Frequencies (VHF) radiation originating at an electromagnetic pulse (EMP) generator located at Los Alamos.
NTIS
Optical Measuring Instruments; Atmospheric Chemistry; Meteorology; Slopes; Electron Density (Concentration)

19990028467 Washington Univ., Dept. of Civil Engineering, Seattle, WA USA
Evaluation of the Effects of Anthropogenic Activity on Streamflow in the Columbia River Basin
Kirschbaum, R. L., Washington Univ., USA; Lettenmaier, D. P., Washington Univ., USA; Sep. 1997; 150p; In English
Report No.(s): PB99-115479; WATER-RESOURCES-SER/TR-156; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The primary objective of this study was to evaluate the macroscale hydrologic effects of anthropogenic changes in vegetation on streamflow. This was accomplished by comparing streamflow predictions based on current and historical vegetation scenarios. The historical frame of reference was the early 1900's and the current frame of reference was the 1990's. Changes in vegetation were represented by the assignment of vegetation parameters extracted from spatial maps of current and historical vegetation type and structural stage, where structural stage is analogous to the condition and/or successional stage of forest stands. The secondary study objective was to assess the sensitivity of predicted changes in streamflow to the specification of vegetation parameters, such as vegetation rooting depth. The model parameter which controls the vertical root distribution profile was varied in small increments as a function of structural stage and the resulting predicted current and historical scenario monthly hydrographs were compared.
NTIS
Columbia River Basin (ID-OR-WA); Environment Effects; Hydrology

19990028643 Department of Energy, Washington, DC USA
Interferometric SAR coherence classification utility assessment
Yocky, D. A., Department of Energy, USA; Mar. 31, 1998; 5p; In English; Geoscience and Remote Sensing, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-005036; SAND-98-0725C; CONF-980715; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The classification utility of a dual-antenna interferometric synthetic aperture radar (IFSAR) is explored by comparison of maximum likelihood classification results for synthetic aperture radar (SAR) intensity images and IPSAR intensity and coherence images. The addition of IFSAR coherence improves the overall classification accuracy for classes of trees, water, and fields. A threshold intensity-coherence classifier is also compared to the intensity-only classification results.
NTIS
Interferometry; Synthetic Aperture Radar; Coherent Radiation; Antenna Arrays

19990028657 Geological Survey, Water Resources Div., Jackson, MS USA
Hydrogeology and Simulation of Ground-Water Flow in the Cretaceous-Paleozoic Aquifer System in Northeastern Mississippi
Strom, E. W., Geological Survey, USA; 1998; 94p; In English
Report No.(s): PB99-114324; USGS/WRI-98-4171; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report describes the hydrogeology and simulations of ground-water flow in the Coffee Sand, Eutaw-McShan, Gordo, Coker, massive sand, and Lower Cretaceous aquifers, and two aquifers recently delineated in Paleozoic rocks in northeastern Mississippi. The report includes descriptions of the aquifers and of a numerical ground-water flow model used to simulate the aquifers. The scope of the report is limited to discussions on predevelopment and 1995 ground-water flow conditions. This report is intended to aid the public and Federal, State, and local-supply and water-management agencies in planning ground-water use.
NTIS
Aquifers; Ground Water; Hydrogeology; Mississippi; Computerized Simulation; Water Flow

19990032045 Army Construction Engineering Research Lab., Champaign, IL USA
Management of Peatland Shrub- and Forest-Dominated Communities for Threatened and Endangered Species *Final Report*
Robertson, Kevin; Harper, Mary G.; Woolery, Mike; Dec. 1998; 107p; In English
Report No.(s): AD-A360447; CERL-TR-99/08; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Plant communities found on peatland soils include forests, basin shrublands, and seepage communities. The ecology and management of six communities are reviewed, with an emphasis on land uses associated with Department of Defense (DoD) installations. Peatland plant communities in the southeastern USA are important to landscape and regional biodiversity because they are often the only natural areas that have not been converted to urban or agricultural uses, and they support several threatened, endangered, and sensitive species (TES). Several of these plant communities are rare due to alterations in fire and hydrology over large expanses of the region. The discussion includes ecological descriptions for each community, information about occurrences on DoD installations throughout the southeast, the contribution of these communities to regional biodiversity, and known occurrences of plant TES associated with these communities. Also included in the discussion are outlines for determining community quality, indicators of quality, known and potential impacts to the integrity of TES habitat for these communities, and management

of these impacts. Special consideration is given to the impacts and management of timber harvesting, alterations in hydrology (drainage), and changes in fire regime since they are most likely to affect peatland communities on DoD installations.
DTIC
Forests; Endangered Species; Communities; Peat; Ecology; Land Management; Environment Management

19990032069 NASA Goddard Space Flight Center, Greenbelt, MD USA
Simple Forest Canopy Thermal Exitance Model
Smith J. A., NASA Goddard Space Flight Center, USA; Goltz, S. M., Maine Univ., USA; IEEE Transactions on Geosciences and Remote Sensing - Communication; Feb. 15, 1999; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We describe a model to calculate brightness temperature and surface energy balance for a forest canopy system. The model is an extension of an earlier vegetation only model by inclusion of a simple soil layer. The root mean square error in brightness temperature for a dense forest canopy was 2.5 C. Surface energy balance predictions were also in good agreement. The corresponding root mean square errors for net radiation, latent, and sensible heat were 38.9, 30.7, and 41.4 W/sq m respectively.
Author
Brightness Temperature; Surface Energy; Canopies (Vegetation); Forests; Root-Mean-Square Errors

19990032120 Geological Survey, Water Resources Div., Raleigh, NC USA
Water Use in Alabama, 1995
Mooty, W. S., Geological Survey, USA; Richardson, J. R., Geological Survey, USA; 1998; 102p; In English
Report No.(s): PB99-123002; USGS/WRI-98-4154; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The report describes total withdrawals from surface- and ground-water sources in Alabama in 1995.
NTIS
Alabama; Water Resources; Water Management

19990032124 Department of Energy, Washington, DC USA
Feasibility of using an east coast facility for collaborative research in atmospheric science
Molitoris, J., Department of Energy, USA; Feb. 9, 1998; 12p; In English
Report No.(s): DE98-058724; UCRL-ID-129741; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This feasibility study examined the effectiveness and potential of a center for collaborative research in atmospheric science and remote sensing. Strongly related to this effort was the development of a telescope facility by Howard University into an atmospheric observatory and remote sensor test-bed. Several remote sensing techniques were evaluated here and the most promising were further developed. Atmospheric assessment concentrated on aerosols, winds, constituent analysis, and the detection of hazardous agents including biologicals. This mission defined the suite of instrumentation. Being a feasibility study, the scope of the project was limited to examining the state of the technology and pushing it when possible. Research performed in applying laser technology lead to the development and subsequent patent application of a new laser heterodyne amplifier, progress toward the development of a laser probe to determine the range resolved size distribution of aerosols, and studies which may lead to the development of a laser induced fluorescence sensing technique for biologicals in the atmosphere. Research in passive atmospheric sensing helped to motivate a field experiment to better understand atmospheric radiance and radiation transport in three-dimensions.
NTIS
Research Facilities; Remote Sensors; Observatories; Earth Atmosphere; Remote Sensing; Atmospheric Chemistry; Atmospheric Sounding; Research Projects

19990032220 Geological Survey, Water Resources Div., Richmond, VA USA
Water Resources Data for Virginia, Water Year, 1998, Volume 2, Ground-Water Level and Ground-Water Quality Records *Annual Report, 1 Oct. 1997 - 30 Sep. 1998*
White, R. K., Geological Survey, USA; Powell, E. D., Geological Survey, USA; Dec. 1998; 422p; In English
Report No.(s): PB99-123432; USGS/WDR/VA-98/2-Vol-2; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The report contains water levels at 338 observation wells and water quality at 86 wells.
NTIS
Virginia; Water Quality; Water Resources; Wells; Ground Water; Hydrology; Potable Water; Water Sampling

19990032255 Department of Energy, Washington, DC USA

Improving terrain height estimates from RADARSAT interferometric measurements

Thompson, P. A., Department of Energy, USA; Eichel, P. H., Department of Energy, USA; Calloway, T. M., Department of Energy, USA; Mar. 31, 1998; 5p; In English; Geoscience and remote sensing, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-005018; SAND-98-0779C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe two methods of combining two-pass RADAR-SAT interferometric phase maps with existing DTED (digital terrain elevation data) to produce improved terrain height estimates. The first is a least-squares estimation procedure that fits the unwrapped phase data to a phase map computed from the DTED. The second is a filtering technique that combines the interferometric height map with the DTED map based on spatial frequency content. Both methods preserve the high fidelity of the interferometric data.

NTIS

Terrain; Radarsat; Interferometry; Elevation; Estimates; Radar Maps

19990032256 Department of Energy, Washington, DC USA

Implementation of SAR interferometric map generation using parallel processors

Doren, N., Department of Energy, USA; Wahl, D. E., Department of Energy, USA; Jul. 31, 1998; 5p; In English; Geoscience and remote sensing, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-005017; SAND-98-0013C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Interferometric fringe maps are generated by accurately registering a pair of complex Synthetic Aperture Radar (SAR) images of the same scene imaged from two very similar geometries, and calculating the phase difference between the two images by averaging over a neighborhood of pixels at each spatial location. The phase difference (fringe) map resulting from this IFSAR operation is then unwrapped and used to calculate the height estimate of the imaged terrain. Although the method used to calculate interferometric fringe maps is well known, it is generally executed in a post-processing mode well after the image pairs have been collected. In that mode of operation, there is little concern about algorithm speed and the method is normally implemented on a single processor machine. This paper describes how the interferometric map generation is implemented on a distributed-memory parallel processing machine. This particular implementation is designed to operate on a 16 node Power-PC platform and to generate interferometric maps in near real-time. The implementation is able to accommodate large translational offsets, along with a slight amount of rotation which may exist between the interferometric pair of images. If the number of pixels in the IFSAR image is large enough, the implementation accomplishes nearly linear speed-up times with the addition of processors.

NTIS

Parallel Processing (Computers); Synthetic Aperture Radar; Interferometry; Radar Maps; Radar Imagery

19990032263 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil

Deforestation in Brazilian Amazonia

May 1992; 4p; In Portuguese; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The National Institute for Space Research (INPE), of the Secretariat of Science and Technology of the Presidency of the Republic of Brazil, has conducted full surveys of Legal Amazonia (about 5 million square kilometers), based on LANDSAT satellite images for the years 1978 (with 1977 and 1976 images used to complete areas covered by clouds in 1978), 1988 (with 1/3 of 1987 images, idem), 1989, 1990 and 1991, to map the extent of gross deforestation (i.e., without accounting for forest regeneration or plantations) in the portion of Legal Amazonia covered by forests, ranging from the dense tropical forest to the thick savannah (cerradao), for a total surface area between 3.9 and 4 million square kilometers. The 1978 survey made use of 232 LANDSAT MSS black-and-white images of channels 5 and 7, at the 1:560,000 scale. The other surveys made use each of 229 LANDSAT TM images in a color composite of channels 3, 4 and 5, at the 1:250,000 scale. The table and the figure also show separately the extent of the degraded secondary forests in Para and Maranhao, formed in regions where tge original forest was removed in great part many years ago.

Author

Deforestation; Brazil; Surveys; Tropical Regions; Research and Development

19990032588 Raytheon STX Corp., Information Technology and Scientific Services, Lanham, MD USA

Effects of Satellite Sampling Configurations on Derived Gridded Fields

Lait, Leslie R., Raytheon STX Corp., USA; 1998; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Various configurations of a scanning satellite instrument are simulated by sampling realistic fields of nitrous oxide. Synoptic grids are computed from the resulting simulated orbital data and compared to the original sampled data fields. Results are

compared with those obtained by flying a simulated satellite over low-resolution fields and fields that are static in time. Although increasing the number of instrument scan positions does provide more information along an orbital swath, using more than three to five scan positions does not significantly increase the accuracy of global synoptic grids using the gridding techniques described here.
Author
Sampled Data Systems; Satellite Configurations; Sampling

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ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

19990028395 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Adding value to coal as feedstock for a hydrogen plant
Lackner, K., Department of Energy, USA; Butt, D., Department of Energy, USA; Jensen, R., Department of Energy, USA; Ziock, H., Department of Energy, USA; Nov. 30, 1997; 13p; In English, USA
Report No.(s): DE98-004320; LA-UR-97-4892; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Coal is the largest fossil energy resource and, in spite of its 19th century image, coal has proven itself in the last quarter of the 20th century as a modern and remarkably cost-effective fuel for generating electric power. Today, with increasing concern over greenhouse gases, coal needs to overcome the obstacle of being the most carbon intensive energy source there is. to clear this hurdle and provide a modern and environmentally viable energy resource based on abundant coal reserves is the goal of Vision 21. The strategy of Vision 21 rests on the production of high quality gaseous fuels like hydrogen that could either leave the plant or be used in the production of electricity by highly efficient fuel cell stacks. Here the authors outline three processing steps, that combined or separately can greatly reduce greenhouse gas emissions from coal. First, they propose to perform the gasification and water-gas shift reaction for producing hydrogen from coal with calcium oxide as a getter for carbon dioxide. This provides an efficient means to collect the carbon dioxide for reuse or disposal. Simultaneously, the carbonation facilitates the formation of hydrogen and provides the energy necessary to drive the hydrogen producing reaction to completion. In the second step, the calcium oxide would be regenerated either by a conventional calcination process or, as they propose to investigate, in a solar furnace. The latter approach would lead to a novel hybrid solar/fossil power plant that derives about 30% of its energy output from solar energy. Finally, they propose to develop a solar driven process, that generates methanol from waste carbon dioxide. In a photolytic process, CO2 is broken up into CO and O2. The CO is then reacted with water in a conventional process to form methanol.
NTIS
Coal; Hydrogen; Coal Gasification; Hydrogen Production; Plants (Botany)

19990028406 Department of Energy, Office of Energy Research, Washington, DC USA
Lateral superlattice solar cells
Mascarenhas, A., Department of Energy, USA; Zhang, Y., Department of Energy, USA; Millunchick, J. M., Department of Energy, USA; Twesten, R. D., Department of Energy, USA; Jones, E. D., Department of Energy, USA; Oct. 31, 1997; 8p; In English; Future General Photovoltaic Technologies, USA
Report No.(s): DE98-000819; SAND-97-1686C; CONF-970396; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A novel structure which comprises of a lateral superlattice as the active layer of a solar cell is proposed. If the alternating regions A and B of a lateral superlattice ABABAB. are chosen to have a Type-2 band offset, it is shown that the performance of the active absorbing region of the solar cell is optimized. In essence, the Type-II lateral superlattice region can satisfy the material requirements for an ideal solar cells active absorbing region, i.e. simultaneously having a very high transition probability for photogeneration and a very long minority carrier recombination lifetime.
NTIS
Solar Cells; Superlattices; Lateral Stability; Boundary Layers

19990028453 Essential Research, Inc., Cleveland, OH USA

A Solar Thermophotovoltaic Electric Generator for Remote Power Applications ***Final Report, Dec. 1996-1998***

Fatemi, Navid S., Essential Research, Inc., USA; Dec. 05, 1998; 31p; In English; Zip(tm) disk: 1 IBM-compatible Zi(tm) disk

Contract(s)/Grant(s): NAS3-97047

Report No.(s): BMDO-95-005; NONP-NASA-DK-1998434829; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; A02, Diskette

We have successfully demonstrated that a solar thermophotovoltaic (TPV) system with a SiC graybody emitter and the monolithic interconnected module device technology can be realized. A custom-designed solar cavity was made to house the SiC emitter and the Monolithic Integrated Module (MIM) strings for testing in a Stirling dish solar concentrator. Five 1x1-cm MIMs, with a bandgap of 0.74 eV, were mounted on a specially designed water-cooled heatsink and were electrically connected in series to form a string. Two such strings were fabricated and tested, as well as high-performance 2x2-cm MIMs with a bandgap of 0.74 eV. Very high output power density values between 0.82 and 0.90 W/ square cm were observed for an average emitter temperature of 1501 K.

Author

Solar Cells; Silicon Carbides; Thermophotovoltaic Conversion; Fabrication; Emitters; Solar Energy Conversion; Indium Gallium Arsenides

19990028470 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Renewable hydrogen production by photosynthetic water splitting

Greenbaum, E., Department of Energy, USA; Lee, J. W., Department of Energy, USA; Jun. 30, 1998; 7p; In English; DOE Hydrogen Program Technical Review Meeting, USA

Report No.(s): DE98-005574; ORNL/CP-98366; CONF-980440; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This mission-oriented research project is focused on the production of renewable hydrogen. The authors have demonstrated that certain unicellular green algae are capable of sustained simultaneous photoproduction of hydrogen and oxygen by light-activated photosynthetic water splitting. It is the goal of this project to develop a practical chemical engineering system for the development of an economic process that can be used to produce renewable hydrogen. There are several fundamental problems that need to be solved before the application of this scientific knowledge can be applied to the development a practical process: (1) maximizing net thermodynamic conversion efficiency of light energy into hydrogen energy, (2) development of oxygen-sensitive hydrogenase-containing mutants, and (3) development of bioreactors that can be used in a real-world chemical engineering process. The authors are addressing each of these problems here at ORNL and in collaboration with their research colleagues at the National Renewable Energy Laboratory, the University of California, Berkeley, and the University of Hawaii. This year the authors have focused on item 1 above. In particular, they have focused on the question of how many light reactions are required to split water to molecular hydrogen and oxygen.

NTIS

Algae; Hydrogen Production; Photosynthesis; Conferences; Water

19990028472 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Development and application of a light-weight, wind-turbine rotor-based data acquisition system

Berg, D. E., Department of Energy, USA; Robertson, P. J., Department of Energy, USA; Ortiz, M. F., Department of Energy, USA; Apr. 30, 1998; 12p; In English; Windpower '98, USA

Report No.(s): DE98-005466; SAND-98-1102C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Wind-energy researchers at the National Wind Technology Center (NWTC), representing Sandia National Laboratories (SNL) and the National Renewable Energy Laboratory (NREL), are developing a new, light-weight, modular data acquisition unit capable of acquiring long-term, continuous time-series data from small and/or dynamic wind-turbine rotors. The unit utilizes commercial data acquisition hardware, spread-spectrum radio modems, and Global Positioning System receivers, and a custom-built programmable logic device. A prototype of the system is now operational, and initial field deployment is expected this summer. This paper describes the major subsystems comprising the unit, summarizes the current status of the system, and presents the current plans for near-term development of hardware and software.

NTIS

Data Acquisition; Wind Turbines; Conferences

19990028617 Southern Research Inst., Research Triangle Park, NC USA

Electric Power Generation Using a Phosphoric Acid Cell on a Municipal Solid Waste Landfill Gas Stream, *Nov. 1997 - Jul. 1998*

Masemore, S., Southern Research Inst., USA; Piccot, S., Southern Research Inst., USA; Aug. 1998; 63p; In English

Contract(s)/Grant(s): EPA-CR-826311

Report No.(s): PB99-118333; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The report gives results of tests to verify the performance of a landfill gas pretreatment unit (GPU) and a phosphoric acid fuel cell system. The complete system removes contaminants from landfill gas and produces electricity for on-site use or connection to an electric grid. Performance data were collected at two sites determined to be representative of the U.S. landfill market. The Penrose facility, in Los Angeles, CA, was the first test site. The landfill gas at this site represented waste gas recovery from four nearby landfills, consisting primarily of industrial waste material. It produced approximately 3000 scf of gas/minute, and had a higher heating value of 446 Btu/scf at about 44% methane concentration. The second test site, in Groton, CT, was a relatively small landfill, but with greater heat content gas (methane levels were about 57% and the average heating value was 585 Btu/scf). The verification test addressed contaminant removal efficiency, flare destruction efficiency, and the operational capability of the cleanup system, and the power production capability of the fuel cell system.

NTIS

Electric Power Supplies; Solid Wastes; Phosphoric Acid Fuel Cells; Gas Recovery; Fuel Systems

19990028792 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Wind tunnel calibration of 5-hole pressure probes for application to wind turbines

Fingersh, L. J., Department of Energy, USA; Robinson, M. C., Department of Energy, USA; May 31, 1998; 7p; In English; 16th; Wind energy, USA; Sponsored by American Society of Mechanical Engineers, USA

Report No.(s): DE98-005792; NREL/CP-500-22134; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A method to quantify the local inflow vector on a rotating turbine blade using a 5-hole static pressure probe was developed at the National Wind Technology Center. The technique permits quantification of dynamic pressure, angle-of-attack and cross-flow-angle to magnitudes of +/-40 deg in any inflow direction parallel to the probe centerline. A description of the static and dynamic calibration procedure, iteration sequence for data reduction, and field results are included.

NTIS

Wind Tunnel Calibration; Wind Turbines; Dynamic Pressure

19990028807 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Effects of variable speed and drive train component efficiencies on wind turbine energy capture

Fingersh, L. J., Department of Energy, USA; Robinson, M. C., Department of Energy, USA; May 31, 1998; 8p; In English; 16th; Wind energy, USA; Sponsored by American Society of Mechanical Engineers, USA

Report No.(s): DE98-005727; NREL/CP-500-22082; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A wind turbine rotor achieves optimal aerodynamic efficiency at a single tip-speed ratio (TSR). to maintain that optimal TSR and maximize energy capture in the stochastic wind environment, it is necessary to employ variable-speed operation. Conventional constant-speed wind turbines have, in the past, been converted into variable-speed turbines by attaching power electronics to the conventional induction generator and gearbox drive train. Such turbines have shown marginal, if any, improvement in energy capture over their constant-speed counterparts. These discrepancies have been shown to be the result of drive train components that are not optimized for variable-speed operation. Traditional drive trains and power electronic converters are designed to achieve maximum efficiency at full load and speed. However, the main energy producing winds operate the turbine at light load for long periods of time. Because of this, significant losses to efficiency occur. This investigation employs a quasi-static model to demonstrate the dramatic effect that component efficiency curves can have on overall annual energy capture.

NTIS

Tip Speed; Wind Turbines

19990028820 Florida Univ., Gainesville, FL USA

Energy Efficient Practices, Products, and Programs for Buildings

Barton, John T.; Jan. 1998; 61p; In English

Report No.(s): AD-A359655; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Energy conservation protects the environment and saves money. The United States have achieved outstanding results so far in energy conservation and efficiency since the oil crises in the 1970's. Yet there are enormous opportunities available in the building industry to further reduce energy usage with the technologies that are available today. This report discusses the different building related energy conservation strategies that can be implemented, examines some of the energy efficient building products, equipment and appliances that are currently available for home and commercial use, and provides operation and maintenance tips. One of the most promising energy efficient practice and product is the photovoltaic technology, which is discussed in chapter 3. Not only is solar energy a sustainable resource and environmentally friendly, it could generate excess energy to feed back into the electric grid system and result in no energy charges for the owner other than the initial installation cost. Finally, this report will examine the EPA Energy Star Buildings and Green Lights program and the Energy Star labeled products intended to encourage the growth and use of energy efficient technologies and practices.
DTIC
Energy Conservation; Energy Consumption

19990028845 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Photovoltaic Energy Program overview: FY 1997, *1997*
Feb. 28, 1998; 29p; In English
Report No.(s): DE98-005093; DOE/GO-10098-539; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The US Department of Energy (DOE) Photovoltaic Energy Program fosters the widespread acceptance of photovoltaic (PV) technology and accelerates commercial use of US PV products. The Program is founded on a collaborative strategy involving industry, the research and development community, potential users, utilities, and state and federal agencies. There are three main Program elements: Systems Engineering and Applications, Technology Development, and Research and Development.
NTIS
Product Development; Technology Utilization; Systems Engineering; Photovoltaic Effect; Electric Power Supplies; Solar Arrays

19990028846 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Experimental study of the factors governing the Staebler-Wronski photodegradation effect in a-Si:H solar cells *Final Report, 7 Jul. 1994 - 15 Jan. 1998*
Han, D., Department of Energy, USA; May 31, 1998; 52p; In English
Report No.(s): DE98-005241; NREL/SR-520-24741; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This report describes continuing studies on electroluminescence (EL), field profile, and hydrogen microstructure by the University of North Carolina, Chapel Hill, during the third year and the extension period. Based on systematic studies of the EL, the authors developed a complete model to explain the unique features of the EL as dispersive-transport-controlled, non-geminate recombinant processes. This model can explain the main features of the EL, not only in hydrogenated amorphous silicon (aSi:H), but also in other types of trap-rich materials. by employing the forward current and EL temperature-dependence studies, information of both the localized tail states and the deep defect states in real solar-cell structures were obtained concomitantly, which is crucial for the device performance. The authors measured the internal electric field profile in p-i-n and n-i-p cells by a null-current method; they studied the structure of the hydrogen clusters in hot-wire a-Si:H films, both theoretically and experimentally, and show a clear evidence of improved structural order in hot-wire a-Si:H, which is an important factor leading to more stable materials. to link the film microstructure to the metastability, the authors also started the film stress measurements.
NTIS
Electroluminescence; Microstructure; Research; Experimentation; Photodecomposition; Solar Cells; Dispersing

19990031962 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Results of the 1997 JPL Balloon Flight Solar Cell Calibration Program
Anspaugh, B. E., Jet Propulsion Lab., California Inst. of Tech., USA; Weiss, R. S., Jet Propulsion Lab., California Inst. of Tech., USA; Dec. 01, 1997; 36p; In English
Report No.(s): JPL-Publ-97-23; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The 1997 solar cell calibration balloon flight campaign consisted of three flights, the first flight on June 11, 1997, the second flight on August 2, 1997, and the third flight on August 24, 1997. One flight, flown on August 14, 1997, was terminated early because of a telemetry transmitter failure, and its payload was reflown on the August 24 flight. All objectives of the flight program were met. Ninety-eight modules were carried to an altitude of approximately 120,000 ft (36.6 km). Full I-V curves were measured on 32 of these modules, and output at a fixed load was measured on 66 modules. This data was corrected to 28 C and to 1 AU

(1.496 x 10(exp 8) km). The calibrated cells have been returned to the participants and can now be used as reference standards in simulator testing of cells and arrays.
Author
Balloon Flight; Modules; Solar Cells; Telemetry; Loads (Forces)

19990032027 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Molten carbonate fuel cell product design improvement tracer tests ***Progress Report, 20 Dec. 1995 - 20 Dec. 1996***
Dec. 31, 1997; 20p; In English
Report No.(s): DE98-058961; DOE/MC/31184-3; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

ERC is developing the detailed design of the commercial entry MW-class power plant. The product requirements and specifications have been derived. The planned baseline power plant is rated at 2.85 MW on natural gas and has a heat rate of 6.22 x 10(exp 6) J/kWh (5900 Btu/kWh; 58% LHV). Additional optional features will be available to include non-standard site conditions and other fuels. In parallel, the baseline product design has progressed to the final design phase. The preliminary product design, which also included parametric optimization, major component vendor interaction, and cost estimation, has been completed during the past year. The power plant approach consists of several factory-constructed truck-transportable modules. A computer- generated power plant layout is shown in a figure. The proposed power plant is expected to have a gross output of 3.03 MW, providing net 2.85 MW AC. The parasitic power loss is approximately 6%, of which, inverter, step-up transformer, BOP motors, and miscellaneous loads consume 2%, 1%, 2%, and 1%, respectively.
NTIS
Molten Carbonate Fuel Cells; Computer Aided Design; Fuel Cell Power Plants; Tracers

19990032059 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Amorphous Silicon Research ***Final Report, 13 Sep. 1994 - 28 Feb. 1998***
Arya, R., Department of Energy, USA; Carlson, D., Department of Energy, USA; Chen, L., Department of Energy, USA; Ganguly, G., Department of Energy, USA; He, M., Department of Energy, USA; Jun. 30, 1998; 56p; In English
Report No.(s): DE98-005786; NREL/SR-520-24854; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Solarex research and development program has focused for the last few years on developing a high-performance amorphous silicon tandem process and on scaling it up to large areas. Significant progress has been made in several areas: (1) improved understanding of the light-induced degradation of amorphous silicon alloys, (2) the processing time for tandem device structures has been reduced by 21%, (3) the feedstock gas utilization has been increased by 30%, (4) stabilized conversion efficiencies of more than 8% have been demonstrated in 4-sq ft tandem modules made in a pilot production mode, and (5) the tandem module process has been transferred to a Solarex manufacturing plant in Virginia that is capable of producing 10 MW of 8.6-sq ft tandem modules per year.
NTIS
Research and Development; Amorphous Silicon

19990032060 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Optimization of Laser Scribing for Thin-Film PV Modules ***Final Report, 12 Apr. 1995 - 11 Oct. 1997***
Compaan, A. D., Department of Energy, USA; Matulionis, I., Department of Energy, USA; Nakade, S., Department of Energy, USA; Jun. 30, 1998; 45p; In English
Report No.(s): DE98-005785; NREL/SR-520-24842; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report covers the work done by the University of Toledo under this subcontract. Researchers determined the threshold power densities for the onset of ablation from thin films of CdTe, CuInSe2, SnO2:F, ZnO:Al, gold, and molybdenum for 12 different wavelength laser systems using wide variations of laser pulse durations. Optimum energy density for the most efficient removal of material during scribing strongly depends on the wavelength of the laser and, to a smaller extent, on the pulse duration. The optimum energy densities range from 0.5 J/sq cm for the 532-nm, 8-nsec YAG pulse on CdTe to 0.2 J/sq cm for the excimer laser at 308 nm on CIS. Poor scribing of CdTe was seen with the 1064-nm beam, ZnO was scribed poorly by all lasers except for the excimer laser. Excellent scribe profiles were observed with the 308-nm excimer lasers on all materials including ZnO.
NTIS
Thin Films; Scoring; Excimer Lasers; Laser Ablation

19990032061 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Atomic-Scale Characterization of Hydrogenated Amorphous-Silicon Films and Devices ***Annual Report, 15 Apr. 1994 - 14 Mar. 1998***
Gallagher, A., Department of Energy, USA; Barzen, S., Department of Energy, USA; Childs, M., Department of Energy, USA; Laracuente, A., Department of Energy, USA; Jun. 30, 1998; 29p; In English
Report No.(s): DE98-005784; NREL/SR-520-24760; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The research is concerned with improving the electronic properties of hydrogenated amorphous silicon (a-Si:H) films and of photovoltaic (PV) cells that use these films. Two approaches toward this goal are being taken. One is to establish the character of silicon particle growth in the rf glow discharges that are used to make the films and PV cells, and to understand the particle incorporation into the films. The ultimate goal of this effort is to find mitigation techniques that minimize the particle incorporation. During this contract period the authors have developed a novel particle light-scattering technique that provides a detailed and sensitive diagnostic of small (8-60 nm diameter) particles suspended in the discharge. The authors have used this to measure the particle growth rates and densities, versus conditions in pure-silane discharges. The second program is directed toward measuring the electronic properties of thin-film PV cells, as a function of depth within the cell. The approach being taken is to use a scanning tunneling microscope (STM) to measure the depth-dependent electronic properties of cross-sectioned PV cells. During the present period, measurements on single and tandem amorphous silicon cells have been carried out. Using STM current-voltage spectroscopy, these measurements distinguish the boundaries between the highly-conducting and intrinsic layers, as well as the chemical potential versus depth in the cell.
NTIS
Electromagnetic Properties; Glow Discharges; Amorphous Silicon; Silicon Films; Photovoltaic Cells

19990032133 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Development of the SEA Corporation Powergrid(trademark) photovoltaic concentrator
Kaminar, N., Department of Energy, USA; Curchod, D., Department of Energy, USA; Daroczi, S., Department of Energy, USA; Walpert, M., Department of Energy, USA; Sahagian, J., Department of Energy, USA; Mar. 31, 1998; 83p; In English
Report No.(s): DE98-004403; SAND-98-0208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report covers the three phase effort to bring the SEA Corporation's Powergrid(trademark) from the concept stage to pilot production. The three phases of this contract covered component development, prototype module development, and pilot line production. The Powergrid is a photovoltaic concentrator that generates direct current electricity directly from sunlight using a linear Fresnel lens. Analysis has shown that the Powergrid has the potential to be very low cost in volume production. During the project, SEA Corporation developed a low cost extruded Fresnel lens, a low cost receiver assembly using one sun type cells, a low cost plastic module housing, a single axis tracking system and frame structure, and pilot production equipment and techniques. In addition, an 800 kW/yr pilot production rate was demonstrated and two 40 kW systems were manufactured and installed.
NTIS
Solar Cells; Manufacturing; Product Development; Fabrication; Prototypes; Photovoltaic Cells; Concentrators; Solar Thermal Electric Power Plants

19990032134 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Renewable generation and storage project industry and laboratory recommendations
Clark, N. H., Department of Energy, USA; Butler, P. C., Department of Energy, USA; Cameron, C. P., Department of Energy, USA; Mar. 31, 1998; 60p; In English
Report No.(s): DE98-004400; SAND-98-0591; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The US Department of Energy Office of Utility Technologies is planning a series of related projects that will seek to improve the integration of renewable energy generation with energy storage in modular systems. The Energy Storage Systems Program and the Photovoltaics Program at Sandia National Laboratories conducted meetings to solicit industry guidance and to create a set of recommendations for the proposed projects. Five possible projects were identified and a three pronged approach was recommended. The recommended approach includes preparing a storage technology handbook, analyzing data from currently fielded systems, and defining future user needs and application requirements.
NTIS
Photovoltaic Conversion; Handbooks; Energy Storage; Photovoltaic Effect

19990032194 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Amorphous silicon research ***Final Report, 1 Aug. 1994 - 28 Feb. 1998***
Guha, S., Department of Energy, USA; May 31, 1998; 97p; In English
Report No.(s): DE98-005498; NREL/SR-520-24724; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the status and accomplishments of work performed under this subcontract by United Solar Systems. United Solar researchers explored several new deposition regimes/conditions to investigate their effect on material/device performance. to facilitate optimum ion bombardment during growth, a large parameter space involving chamber pressure, rf power, and hydrogen dilution were investigated. United Solar carried out a series of experiments using discharge modulation at various pulsed-plasma intervals to study the effect of Si-particle incorporation on solar cell performance. Hydrogen dilution during deposition is found to improve both the initial and stable performance of a-Si and a-SiGe alloy cells. Researchers conducted a series of temperature-ramping experiments on samples prepared with high and low hydrogen dilutions to study the effect of hydrogen effusion on solar cell performance. Using an internal photoemission method, the electrical bandgap of a microcrystalline p layer used in high-efficiency solar cells was measured to be 1.6 eV. New measurement techniques were developed to evaluate the interface and bulk contributions of losses to solar cell performance. Researchers replaced hydrogen with deuterium and found deuterated amorphous silicon alloy solar cells exhibit reduced light-induced degradation. The incorporation of a microcrystalline n layer in a multijunction cell is seen to improve cell performance. United Solar achieved a world-record single-junction a-Si alloy stable cell efficiency of 9.2% with an active area of 0.25 sq cm grown with high hydrogen dilution. They also achieved a world-record triple-junction, stable, active-area cell efficiency of 13.0% with an active area of 0.25 sq cm
NTIS
Amorphous Silicon; Solar Cells

19990032201 Research Triangle Inst., Research Triangle Park, NC USA
Biomass Power Plant Demonstration at Camp Lejeune, ***Jul. 1994 - Jul. 1998***
Schmidt, D. D., Research Triangle Inst., USA; Purvis, C. R., Research Triangle Inst., USA; Cleland, J. G., Research Triangle Inst., USA; 1998; 12p; In English
Contract(s)/Grant(s): CR-822871
Report No.(s): PB99--126476; EPA/600/A-98/141; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The paper discusses a biomass power plant at Camp Lejeune, undertaken to demonstrate that biomass energy conversion is a competitive lower-polluting, electrical power option for government installations, industrial sites, rural cooperatives, small municipalities, and regions of developing countries. The plant incorporates a moving bed bulk wood dryer; a downdraft, fixed-bed gasifier utilizing hogged wood residues; a gas cleaning and cooling system; and a spark ignition engine. Operation of the plant has resulted in characterization of all major technical challenges and provided solutions. The paper briefly describes the process design, initial operational results, and further needs.
NTIS
Electric Power Plants; Biomass Energy Production; Military Air Facilities; Air Pollution; Bioconversion

19990032248 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Characterization of low-melting electrolytes for potential geothermal borehole power supplies: The LiBr-KBr-LiF eutectic
Guidotti, R. A., Department of Energy, USA; Reinhardt, F. W., Department of Energy, USA; May 31, 1998; 11p; In English; 193rd, USA; Sponsored by Electrochemical Society, Inc., USA
Report No.(s): DE98-005458; SAND-98-1105C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The suitability of modified thermal-battery technology for use as a potential power source for geothermal borehole applications is under investigation. As a first step, the discharge processes that take place in LiSi/LiBr-KBr-LiF/FeS2 thermal cells were studied at temperatures of 350 C and 400 C using pelletized cells with immobilized electrolyte. Incorporation of a reference electrode allowed the relative contribution of each electrode to the overall cell polarization to be determined. The results of single-cell tests are presented, along with preliminary data for cells based on a lower- melting CsBr-LiBr-KBr eutectic salt.
NTIS
Melting; Electrolytes; Boreholes; Eutectics; Thermal Batteries; Potassium Bromides; Lithium Fluorides

19990032324 NASA Marshall Space Flight Center, Huntsville, AL USA

The 1998 NASA Aerospace Battery Workshop

Brewer, Jeffrey C., Compiler, NASA Marshall Space Flight Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999; 724p; In English; 31st, 27-29 Oct. 1998, Huntsville, AL, USA; Sponsored by NASA, USA; See also 19990032325 through 19990032353

Report No.(s): NASA/CP-1999-209144; M-912; NAS 1.55:209144; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

This document contains the proceedings of the 31st annual NASA Aerospace Battery Workshop, hosted by the Marshall Space Flight Center on October 27-29, 1998. The workshop was attended by scientists and engineers from various agencies of the U.S. Government, aerospace contractors, and battery manufacturers, as well as international participation in like kind from a number of countries around the world. The subjects covered included nickel-hydrogen, silver-hydrogen, nickel-metal hydride, and lithium-based technologies, as well as results from destructive physical analyses on various cell chemistries.

Author

Conferences; Electric Batteries; Nickel Hydrogen Batteries; Performance Tests; Acceptability

19990032325 Design Automation Associates, Enfield, CT USA

Design Automation Associates, Inc. Rule Based Development Partner

Lambert, John C., Design Automation Associates, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 1-37; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation starts with a brief overview of the Design Automation Associates company, including a review of the competencies, and work they have done. The presentation proceeds to report on two systems which have been created: (1) the NiMH (Bi-Polar) battery design system, which allows designers to conduct comprehensive battery and cell trade studies, rapidly, and (2) an NiH2 Battery concept design system. Both systems are reviewed and demonstrated. Using the NiMH system, designers can conduct complex structural and thermal analysis without in-depth knowledge of these specialized disciplines. The system incorporates cell and hardware information, and cost information with sensitivity studies, iteration based on cell orientations with a graphical user interface. The highlights include: (1) prismatic or cylindrical designs, (2) hogged out or honeycomb end plates, (3) rapid fatigue analysis, (4) rapid thermal analysis, (5) multiple battery designs can be considered simultaneously, (6) flexibility and expandability. The outputs of the system include: (1) the battery summary and a 3D model, (2) extensive inputs report, (3) summaries of the weight and the breakdown by battery, cell and hardware, (4) producibility report and maintenance guidelines, (5) costed bill of materials (BOMS) recurring and non-recurring, (6) detailed two dimensional drawings and details, (7) sensitivity study and (8) fatigue life summary. The NiH2 system, allows non-expert designers to conduct comprehensive battery and cell trade studies rapidly. The system includes an advanced user interface, and produces cell evaluation and battery configurations as opposed to a detailed design. It includes intensive iteration, and trade study capability, optimized cell arrangement, accurate depth of discharge calculation, and automated thermal analysis. It produces a viable options report, a key parameter report, a cell cross section, parts list, cell arrangements and thermal results. The future direction is to develop an integrated battery evaluation system.

CASI

Electric Batteries; Fatigue Life; Nickel Hydrogen Batteries; Structural Analysis; Computer Aided Design; Computer Programs; Applications Programs (Computers)

19990032326 NASA Goddard Space Flight Center, Greenbelt, MD USA

Thermal Control Using Electrochromism

Vaidyanathan, Hari, Communications Satellite Corp., USA; Rao, Gopalakrishna, NASA Goddard Space Flight Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 39-59; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The applicability of a charge balanced electrochromic device to modulate the frequencies in the thermal infrared region is examined in this study. The device consisted of a transparent conductor, WO3, anode, PMMA/LiClO4 electrolyte, V2O5 cathode and transparent conductor. The supporting structure in the device is SnO2 coated glass and the edges are sealed with epoxy to reduce moisture absorption. The performance evaluation comprised of cyclic voltammetric measurements and determination of transmittance at various wavelengths. The device was subjected to anodic and cathodic polarization by sweeping the potential at a rate of 10 mV/sec from -0.8V to 1.8V. The current versus voltage profile indicated no reaction between -0.5 and +0.5 V. The device is colored green at 1.8 V with a transmittance of 5% at a wavelength, lambda = 900 nm and colorless at -0.8 V with a transmittance of 74% at lambda = 500 nm. The optical modulation is limited to 400-1500 nm and there is no activity in the thermal infrared. The switching time is a function of temperature and time for coloring reaction was slower than the bleaching reaction.

The device yielded reproducible values for transmittance when cycled between colored and bleached states by application of 1.8V and -0.8V, respectively.
Author
Electrochromism; Performance Tests; Temperature Control; Electro-Optics; Thin Films; Electric Potential

19990032327 NASA Johnson Space Center, Houston, TX USA
Battery/Ultracapacitor Evaluation for X-38 Crew Return Vehicle (CRV)
Darcy, Eric, NASA Johnson Space Center, USA; Strangways, Bradley, Symmetry Resources, Inc., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 61-90; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation reported on the evaluation of the battery/ultracapacitor for the crew return vehicle (CRV). The CRV, as part of the international space station (ISS) planning, will be available to return to earth an ill or injured crew person, or if the ISS becomes unsafe, and the shuttle is not available. The requirements of the X-38 CRV are reviewed, and in light of the power requirements, the battery's required performance is reviewed. The ultracapacitor bank, and its test method is described. The test results are reviewed. A picture of the test set up is displayed showing the ultracapacitor bank and the NiMH battery. The presentation continues by reviewing tests of 5 available trade high power cell designs: (1) Hawker lead acid, (2) Bolder lead acid, (3) Energizer NiMH, (4) Sanyo NiCd, and (5) Energizer NiCd. The test methods and results are reviewed. There is also a review of the issues concerning lead acid batteries and conclusions.
CASI
Electric Batteries; International Space Station; X-38 Crew Return Vehicle; Capacitors; Electric Potential; Electric Current

19990032328 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
DS-2 Mars Microprobe Battery
Frank, H., Jet Propulsion Lab., California Inst. of Tech., USA; Kindler, A., Jet Propulsion Lab., California Inst. of Tech., USA; Deligiannis, F., Jet Propulsion Lab., California Inst. of Tech., USA; Davies, E., Jet Propulsion Lab., California Inst. of Tech., USA; Blankevoort, J., Jet Propulsion Lab., California Inst. of Tech., USA; Ratnakumar, B. V., Jet Propulsion Lab., California Inst. of Tech., USA; Surampudi, S., Jet Propulsion Lab., California Inst. of Tech., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 91-111; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

In January of 1999 the NM DS-2 Mars microprobe will be launched to impact on Mars in December. The technical objectives of the missions are to demonstrate: key technologies, a passive atmospheric entry, highly integrated microelectronics which can withstand both low temperatures and high decelerations, and the capability to conduct in-situ, surface and subsurface science data acquisition. The scientific objectives are to determine if ice is present below the Martian surface, measure the local atmospheric pressure, characterize the thermal properties of the martian subsurface soil, and to estimate the vertical temperature gradient of the Martian soil. The battery requirements are 2-4 cell batteries, with voltage of 6-14 volts, capacity of 550 mAh at 80C, and 2Ah at 25C, shelf life of 2.5 years, an operating temperature of 60C and below, and the ability to withstand shock impact of 80,000 g's. The technical challenges and the approach is reviewed. The Li-SOCL2 system is reviewed, and graphs showing the current and voltage is displayed, along with the voltage over discharge time. The problems encountered during the testing were: (1) impact sensitivity, (2) cracking of the seals, and (3) delay in voltage. A new design resulted in no problems in the impact testing phase. The corrective actions for the seal problems involved: (1) pre weld fill tube, (2) an improved heat sink during case to cover weld and (3) change the seal dimensions to reduce stress. to correct the voltage delay problem the solutions involved: (1) drying the electrodes to reduce contamination by water, (2) assemblage of the cells within a week of electrode manufacture, (3) ensure electrolyte purity, and (4) provide second depassivation pulse after landing. The conclusions on further testing were that the battery can: (1) withstand anticipated shock of up to 80,000 g, (2) meet the discharge profile post shock at Mars temperatures, (3) meet the required self discharge rate and (4) meet environmental requirements.
CASI
Design Analysis; Electric Batteries; Impact Tests; Mars Surface; Planetary Temperature; Service Life; Mars Exploration; Electric Power Supplies; Electric Potential; Electric Current; Electrical Resistance

19990032329 NASA Goddard Space Flight Center, Greenbelt, MD USA
Design and Flight Performance of NOAA-K Spacecraft Batteries
Rao, Gopalakrishna M., NASA Goddard Space Flight Center, USA; Chetty, P. R. K., Kris Engineering, Inc., USA; Spitzer, Tom, NASA Goddard Space Flight Center, USA; Chilelli, P., Lockheed Martin Missiles and Space, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 113-138; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The US National Oceanic and Atmospheric Administration (NOAA) operates the Polar Operational Environmental Satellite (POES) spacecraft (among others) to support weather forecasting, severe storm tracking, and meteorological research by the National Weather Service (NWS). The latest in the POES series of spacecraft, named as NOAA-KLMNN, is in orbit and four more are in various phases of development. The NOAA-K spacecraft was launched on May 13, 1998. Each of these spacecraft carry three Nickel-Cadmium batteries designed and manufactured by Lockheed Martin. The battery, which consists of seventeen 40 Ah cells manufactured by SAFT, provides the spacecraft power during the ascent phase, orbital eclipse and when the power demand is in excess of the solar array capability. The NOAA-K satellite is in a 98 degree inclination, 7:30AM ascending node orbit. In this orbit the satellite experiences earth occultation only 25% of the year. This paper provides a brief overview of the power subsystem, followed by the battery design and qualification, the cell life cycle test data, and the performance during launch and in orbit.
Author
Meteorological Services; Nickel Cadmium Batteries; NOAA Satellites; Electric Power Supplies; Life (Durability)

19990032330 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Lithium-Ion Batteries for Aerospace Applications
Surampudi, S., Jet Propulsion Lab., California Inst. of Tech., USA; Halpert, G., Jet Propulsion Lab., California Inst. of Tech., USA; Marsh, R. A., Air Force Research Lab., USA; James, R., Air Force Research Lab., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 141-159; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation reviews: (1) the goals and objectives, (2) the NASA and Airforce requirements, (3) the potential near term missions, (4) management approach, (5) the technical approach and (6) the program road map. The objectives of the program include: (1) develop high specific energy and long life lithium ion cells and smart batteries for aerospace and defense applications, (2) establish domestic production sources, and to demonstrate technological readiness for various missions. The management approach is to encourage the teaming of universities, R&D organizations, and battery manufacturing companies, to build on existing commercial and government technology, and to develop two sources for manufacturing cells and batteries. The technological approach includes: (1) develop advanced electrode materials and electrolytes to achieve improved low temperature performance and long cycle life, (2) optimize cell design to improve specific energy, cycle life and safety, (3) establish manufacturing processes to ensure predictable performance, (4) establish manufacturing processes to ensure predictable performance, (5) develop aerospace lithium ion cells in various AH sizes and voltages, (6) develop electronics for smart battery management, (7) develop a performance database required for various applications, and (8) demonstrate technology readiness for the various missions. Charts which review the requirements for the Li-ion battery development program are presented.
CASI
Electric Batteries; Electrode Materials; Life (Durability); Lithium; Manufacturing; Technology Assessment

19990032331 National Space Development Agency, Electronic and Information Technology Dept., Tokyo, Japan
The Applicability of Lithium Ion Secondary Battery Cells to Space Programs
Sone, Yoshitsugu, National Space Development Agency, Japan; Kusawake, Hiroaki, National Space Development Agency, Japan; Kanno, Koichi, National Space Development Agency, Japan; Kuwajima, Saburo, National Space Development Agency, Japan; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 161-191; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation first reviews the results of tests on commercial cells. These tests showed that through the life cycle tests, commercial test cell performance depends on depth of discharge (DOD). The degradation of cell performance affected by EOCV was observed, while the same type of degradation was not always observed through all measurements. In reference to the Lithium Ion secondary cells for H-II Orbiting Plane Experimental (HOPE-X), the comparison of the capacity obtained by CC-CV and CC steps, resulted in the conclusion that the charge methods did not cause a significant difference in the capacity. Also, HOPE-X simulation tests, confirmed that this cell is applicable to the program. In the current and future tests of the Lithium Ion secondary cells the researchers hope to pay attention to the performance of EOCV through the life cycle test, to ascertain whether they will need a controlling unit for each cell, and what type of controlling methods will be used.
CASI
Life (Durability); Lithium; Storage Batteries; Hope Aerospace Plane; Charge Efficiency; Electric Charge; Electric Current

19990032332 Eagle-Picher Technologies, LLC, Advanced Electrochemical Systems Operation, Joplin, MO USA
Testing of the Eagle-Picher Lithium-Ion System
Kelly, Chad, Eagle-Picher Technologies, LLC, USA; Wilson, Shellie, Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 193-201; In English; See also 19990032324; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This paper reviews the tests, both planned and completed for the Lithium-Ion cells, and the Lithium Ion Battery. Graphs are presented which shows results of the completed tests; and includes the preliminary results of the tests which are still ongoing. The tests include tests to ascertain the thermal characteristics cycle life tests, and shock and vibration environments test. The achievements are summarized: (1) completed the thermal model; (2) completed preliminary shock and vibration testing, achieved more than 12,000 cycles at 10% depth of discharge, and more than 9,000 cycles at 100 depth of discharge, the accumulation of Lithium-Ion comparison data, and NiH2 batteries. There is a summary of the development plans for 1999, at both the cell level and the battery level.

CASI

Electric Batteries; Life (Durability); Lithium; Shock Tests; Vibration Tests

19990032333 NASA Johnson Space Center, Houston, TX USA
Evaluation of Safety and Performance of Sony Lithium Ion Cells
Jeevarajan, Judith A., Lockheed Martin Corp., USA; Bragg, Bobby J., NASA Johnson Space Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 203-222; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper reports on results of the tests of the Sony Lithium Ion Cells. The physical, electrochemical, and Canon Battery (BP-927) characteristics of the cells are reported. The tests given include overcharge, overdischarge, high temperature, drop tests, external short circuit, crush test, thermal tests on battery pack, overcharging and overdischarging, unbalanced configuration, heat to vent, and the vibration test. The tests are described, and the results of the tests are reviewed.

CASI

Electric Batteries; Electronic Equipment Tests; Lithium; Safety

19990032334 Electro Energy, Inc., Danbury, CT USA
Bipolar Nickel-Metal Hydride Battery Development Project
Cole, John H., Electro Energy, Inc., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 223-263; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper reviews the development of the Electro Energy, Inc.'s bipolar nickel metal hydride battery. The advantages of the design are that each cell is individually sealed, and that there are no external cell terminals, no electrode current collectors, it is compatible with plastic bonded electrodes, adaptable to heat transfer fins, scalable to large area, capacity and high voltage. The design will allow for automated flexible manufacturing, improved energy and power density and lower cost. The development and testing of the battery's component are described. Graphic presentation of the results of many of the tests are included.

CASI

Bipolarity; Electric Batteries; Metal Hydrides; Nickel Compounds; Electrodes

19990032335 NASA Johnson Space Center, Houston, TX USA
Battery Study for the Shuttle Orbiter EAPU Upgrade
Otzinger, Burton, Boeing Defense and Space Group, USA; Hwangbo, S., Boeing Defense and Space Group, USA; Farkas, T., Boeing Defense and Space Group, USA; Schwartz, George, Boeing Defense and Space Group, USA; Gajewski, M., Boeing Defense and Space Group, USA; Verzwyvelt, S., Boeing Defense and Space Group, USA; Barrera, T., Boeing Defense and Space Group, USA; Barrera, B., Boeing Defense and Space Group, USA; Johnson, C., Boeing Defense and Space Group, USA; Irlbeck, B., NASA Johnson Space Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 265-293; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The use of Electric Auxiliary Power Unit (EAPU) in commercial, and military aviation, and in commercial electric automobiles, is reviewed. The specifications of the battery to be used in the space shuttle are reviewed, and the possible vendors discussed. The testing activity and the reliability and the safety features are presented.

CASI

Auxiliary Power Sources; Electric Batteries; Reliability; Safety; Electric Power Supplies; Spacecraft Power Supplies; Lithium

19990032336 Aerospace Corp., Electronics Technology Center, El Segundo, CA USA

Expert System for Nickel Hydrogen Battery Cell Diagnostics

Zimmerman, A., Aerospace Corp., USA; Thaller, Lawrence, Aerospace Corp., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 297-316; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The diagnosis of the root-cause or causes for performance problems in battery cells is often a difficult task because each of the component characteristics, physical processes, or chemical processes in most battery cells typically has a strong interaction with many other variables in the cell. In nickel hydrogen battery cells this is particularly true because of the co-existence of solid, liquid, and gaseous active phases, each of which can provide coupling between the components and processes that occur within the cell. In nickel hydrogen cells, as is the case for most battery cells, diagnostic procedures in the event of performance problems typically involve the combination of some electrical tests (hopefully perceptive), cell disassembly and inspection, and physical/chemical analysis of the cell components. All laboratories that perform such DPA (Destructive Physical Analysis) procedures have a somewhat different set of procedures and analyses that are followed. Some analyses may be either more or less appropriate for any given cell, depending on the performance signatures of that cell. However, typically a standard DPA regimen is utilized by any given laboratory, with the expectation that a broad range of analysis procedures will yield the key information needed to diagnose the root cause for the cell problems. A more efficient approach to the DPA of battery cells in general (and nickel hydrogen cells as discussed herein) has been developed at The Aerospace Corporation. This approach defines a DPA in terms applying the correct diagnostic procedures from a large toolbox of procedures, performing only those analyses that are most appropriate for the observed behavior of the battery cell. Thus, with this approach, the details of each DPA procedure are generally different from all other DPA procedures. The most appropriate procedures to be used for a given DPA are those that have the greatest likelihood of yielding the root cause for the cell performance problems or degradation modes. Determination of the most appropriate analysis associated with each root cause (and its performance signatures) is based on a combination of performance modeling, experience, and the known symptoms exhibited by the cell. This approach to the perceptive DPA of nickel hydrogen battery cells has been codified into an expert system for nickel hydrogen battery cell DPA, which will be described here along with examples to both validate the system and illustrate its use.

Derived from text

Diagnosis; Electric Batteries; Expert Systems; Nickel Hydrogen Batteries; Performance Prediction; Failure Analysis

19990032337 Aerospace Corp., El Segundo, CA USA

Nickel Electrode Failure by Chemical De-Activation of Active Material

Zimmerman, A., Aerospace Corp., USA; Quinzio, M., Aerospace Corp., USA; To, G., Aerospace Corp., USA; Adams, P., Aerospace Corp., USA; Thaller, L., Aerospace Corp., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 317-328; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A nickel hydrogen battery cell that had experienced early life failure in an accelerated life-test was disassembled and analyzed to determine the underlying cause for the failure. Cell failure was clearly the result of a large loss of usable capacity in the sintered nickel electrodes. This failure was not associated with electrode swelling, sinter corrosion, loss of cobalt additives, poor active material conductivity, or poor charge efficiency, all of which are known degradation processes in nickel electrodes. The failure of these electrodes was linked directly to the formation of a nickel oxide-hydroxide phase Ni2O3H that has not been previously linked to failure in nickel electrodes. This material appears to be electrochemically inert, resulting in up to 50% loss of usable active material in these electrodes. The formation of this material was highly non-uniform through the cell, being concentrated in regions where the electrode temperature was expected to be greatest. Ongoing study is evaluating the specific conditions in the nickel electrode that accelerate failure due to formation of Ni2O3H.

Author

Accelerated Life Tests; Failure; Nickel Hydrogen Batteries; Nickel Oxides; Charge Efficiency; Electrodes; Spacecraft Power Supplies; Deactivation

19990032338 Naval Surface Warfare Center, Crane, IN USA

Design Performance Analysis: Studies of Component Degradation and Silver Migration in Experimental Silver-Zinc Cells

Lewis, Harlan L., Naval Surface Warfare Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 329-348; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The concept of Design Performance Analysis (DPA) is discussed. DPA when applied to electrochemical cells, is an attempt to evaluate the influence of each of the components of a particular electrochemical cell chemistry on the performance characteristics of that chemistry. The approach to experimental design is discussed, and the application to a specific study of Silver Zinc Separation is studied. Charts which show various features of the process are shown. A chart shows the physical properties, tensile

strength and crystallinity, of cellophane treated using three different methods, and clear cellophane. Another chart shows the degree of polymerization during chemical degradation at 50 C. Others show the silver content, (1) form cycle life cell study, (2) of separation by layer, and (3)form wet life cell study. Graphs show the discharge cycle life, and discharge wet life. An evaluation of the data and conclusions are included. Silver treatment of cellophane film for separator applications in rechargable silver zinc cells appears to result in improved resistance to electrolyte degradation, longer cell cycle life, less tendency to short development and lower silver migration rates.
CASI
Cellophane; Chemical Properties; Electrochemical Cells; Electrolytic Cells; Experiment Design; Silver Zinc Batteries; Wet Cells; Life (Durability)

19990032339 Naval Surface Warfare Center, Crane, IN USA
Studies of Component Degradation During Testing of Nickel-Hydrogen Cells
Wharton, Steve, Naval Surface Warfare Center, USA; Brown, Harry, Naval Surface Warfare Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 349-375; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The Naval Surface Warfare Center has been involved in the test and evaluation (T&E) of nickel-hydrogen (Ni/H2) electrochemical power sources for almost fourteen years. One test-pack of Ni/H2 Independent Pressure Vessel (IPV), 125Ah, 1.2VDC cells has been on-test for almost ten years, and five of the six total cells have finally failed. The last three, longest-lived cells have all completed over 46,640 simulated 90 minute low earth-orbit (LEO) cycles--an equivalent of almost eight years or more of continuous service. The one remaining cell has completed over 53,735 cycles, and is still cycling. These three long-lived cells all contain a catalyzed wall-wick (CWW) as an advanced design-feature being evaluated to extend cell service life. The CWW is designed for two main purposes including: to aid in uniform electrolyte distribution (through wall-wicking), and to act as an alternate (catalytic) surface upon which hydrogen and oxygen gases can recombine to minimize negative (NEG) electrode degradation from this destructive, ”popping,” recombination. It is important to note that the only difference between these two groups of three cells is the CWW, and that the tops of the cells are the POS-end up during all of the lifecycle testing. This paper presents some of the significant observations of destructive physical analysis (DPA) of the five failed cells and discusses these findings. It is presented in the format of 21 color photographs and numerous other written observations of the condition of key internal components of these test cells.
Derived from text
Electric Power Supplies; Electrodes; Electrolytes; Nickel Hydrogen Batteries; Service Life

19990032340 NASA Lewis Research Center, Cleveland, OH USA
Destructive Physical Analysis of Flight- and Ground-Tested Sodium-Sulfur Cells
Wasz, Margot L., Aerospace Corp., USA; Carter, Boyd J., Aerospace Corp., USA; Donet, Charles M., Air Force Research Lab., USA; Baldwin, Richard S., NASA Lewis Research Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 377-398; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Destructive physical analysis (DPA) was used to study the effects of microgravity on the sulfur electrode in sodium-sulfur cells. The cells examined in this work were provided by the Air Force Research Laboratory (AFRL) from their program on sodium-sulfur technology. The Naval Research Laboratory (NRL) provided electrical characterization of the flight-tested and ground-tested cells.
Author
Electrodes; Destructive Tests; Sodium Sulfur Batteries; Inert Atmosphere; Electrolytes; Microgravity; Gravitational Effects

19990032341 Centre National d’Etudes Spatiales, Toulouse, France
Using DPA Results From Boiler Plate NiH2 Cells to Help Understand Design Limitations and Validate New Cell Components
Jamin, Thierry, Centre National d’Etudes Spatiales, France; Schautz, Max, European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 399-439; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Research is continuously underway to promote the use of new materials in aerospace cells. Boiler plate testing as a preliminary step is helpful in running an almost representative evaluation under cycling. Functional features comparison helps to under-

stand the behavior evolution with aging. Accelerated GEO cycling (rapid cycle or wear out) were performed on BP incorporating Z2 foam based or Z28 dry sinter at 1OC.
Derived from text
Sintering; Nickel Hydrogen Batteries; Electrodes; Electrolytes; Life (Durability); Accelerated Life Tests

19990032342 Mine Safety Appliances Co., Sparks, MD USA
Destructive Physical Analysis of Lithium-Ion Cells
Issacs, Nathan, Mine Safety Appliances Co., USA; Baker, John, Mine Safety Appliances Co., USA; Bytella, Joseph, Mine Safety Appliances Co., USA; Richardson, Ken, Mine Safety Appliances Co., USA; Stein, Brian, Mine Safety Appliances Co., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 441-479; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The preparation of effective Destructive Physical Analysis (DPA) procedures is an important element of Mine Safety Appliances (MSA)'s Li-Ion development program. New methods are needed for analysis of organic components and other materials not being used in Ni-H2 and Ni-Cd cells. Likewise, physical structures are different, requiring new DPA methods. Several examples of DPA procedures are presented. Data are presented on the DPA of a prototype, prismatic, 15-Ah, Li-ion cell currently under development at MSA. Plate-to-plate resistance buildup, vibration results, and gas sampling data are presented. DPAs were also performed on 1991-vintage, SONY 20500 Li-ion cells and on 1996-vintage, SONY 18650 Li-ion cells. Anode and cathode materials in both cell sets are compared. The anodes and cathodes were studied (using ICP) for lithium content in both charged and discharged states. Other analytical studies were conducted using SEMS-EDS, GC, GC-MS, TGA, TGA-MS, DSC, and laser light-scattering particle analysis. FTIR was used to analyze residues on current collector foils.
Author
Cathodes; Cathodic Coatings; Lithium; Metal Ions; Electrical Resistance; Electric Batteries

19990032343 Eagle-Picher Technologies, LLC, Power Subsystems, Joplin, MO USA
Proposed Convention for Assigning NiH2 Cell Capacity
Wheeler, James R., Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 483-502; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper discusses a proposed convention for assigning NiH2 Cell capacity. The current practice of the manufacturers assigning values is problematic because there is no standard convention to define "nominal" capacity. The presenter proposes a definition for the nominal capacity of a NiH2 cell as being equal to the theoretical capacity, rounded to the nearest whole number of the active material in its positive electrodes, if they were of nominal loading, thickness and porosity. A consistent basis for comparisons needed to: (1) compare cell design features, (2) compare effects of testing methods, (2) compare current flight performance, (4) control precharge, (5) project battery cycle life, (5) compare NiH2 to Li-ION, NiCd batteries, and (6) better exploit existing depth of discharge capabilities, which are under-used.
CASI
Electric Batteries; Electrodes; Life (Durability); Standards; Nickel Hydrogen Batteries; Electrolytic Cells

19990032344 Lockheed Martin Missile and Space, Sunnyvale, CA USA
NiH2 Battery Reliability Update
Hafen, Douglas P., Lockheed Martin Missile and Space, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 503-520; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation is concerned with updating the reliability equation for Nickel Hydrogen Batteries. A reliability equation has been developed for state-of-the-art Nickel Hydrogen cells, such as those used on the Hubble Space telescope. The equation is a relationship between operating Depth of discharge (DOD), cycles experienced, battery reliability, number of batteries/cells and allowable failures. Typically the solution being sought is battery reliability, maximum allowable depth of discharge or cycle life. Other relationships such as probability of success vs. cycle life may also be developed. The equation set will not apply if less than optimum design is used.
CASI
Life (Durability); Nickel Hydrogen Batteries; Reliability; Equations; Performance Prediction

19990032345 Eagle-Picher Technologies, LLC, Joplin, MO USA
High DOD LEO Life Cycle Testing
Dermott, Jeff, Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 521-534; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation reviews the high depth of discharge (DOD) Low Earth Orbit (LEO) life cycle testing performed on four cell lots. The test conditions, and the test itself is described. Line graphs of the life cycle test data, show the EOCV, and the EODV for all 4 cell types. Two cells were removed from the lots at cycle 15,800 for EOL, and one of the Boiler plate cells, and one of the control cells. The Beginning of Life (BOL) acceptance and a destructive physical analysis (DPA) test was performed on those cells. The results of the tests on those two cells are shown in charts and graphs. The DPA is summarized.
CASI
Life (Durability); Electric Batteries; Electrolytic Cells; Spacecraft Power Supplies; Charge Efficiency

19990032346 National Space Development Agency, Tokyo, Japan
Ni-H2 Batteries Performance on Communication and Broadcasting Engineering Test Satellite
Kusawake, H., National Space Development Agency, Japan; Sone, Y., National Space Development Agency, Japan; Kanno, K., National Space Development Agency, Japan; Nakamura, T., National Space Development Agency, Japan; Kuwajima, S., National Space Development Agency, Japan; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 535-558; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The performance of the NiH2 Batteries on the Communication and Broadcasting Engineering test Satellite (COMETS) is reviewed in this presentation. A description of the COMETS is given, along with the specifications of the 35Ah Space NiH2 cell and battery. Due to a failure of the launch vehicle, COMETS was not injected into geostationary orbit. Seven maneuvers were used for getting higher apogee altitude using the apogee engine to boost the satellite into the desired orbit. The NiH2 batteries are charged during sunshine time and discharged during the eclipse time. Until the boost maneuvers were completed, the batteries were not charged for a long enough time to be charged by the charge arrays. Therefore a heater operation was used which saved the discharge amount of the batteries. Graphs show: (1) the boost maneuver operation, (2) the orbital eclipse profile, (3) the generated power (effected by the radiation from the Van Allen radiation belts), and (4) progress of operation on orbit. Trendlines are given which show the performance of the batteries, in terms of battery voltage, and the elapsed days, the EOCV, and EODV during the 2nd Eclipse season, and the trend of the batteries during the 1st full sunshine season, when the first full recharge could be achieved. Graphs also show the charge and discharge characteristics, the performance of the NiH2 Battery during the third boost maneuver, and the transition of the depth of discharge.
CASI
Engineering Test Satellites; Nickel Hydrogen Batteries; Spacecraft Power Supplies; Battery Chargers; Storage Batteries; Orbit Insertion; Japanese Spacecraft; Electric Discharges

19990032347 Eagle-Picher Technologies, LLC, Power Subsystems, Joplin, MO USA
Reversal as a Tool for Assessing Precharge of Nickel Hydrogen Cells
Brill, Jack N., Eagle-Picher Technologies, LLC, USA; Smith, Ron, Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 559-577; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper describes tests and results of the tests using reversal of precharge of nickel hydrogen cells. Knowing the cell's precharge allows the user to better define storage methods. Extended wet storage has increased concern with respect to a nickel hydrogen cell's precharge. The results are presented graphically. The test showed that: (1) the signature of the voltage curve at low rate reversal can be used as a tool to identify precharge; (2) a low rate charge from a fully discharged cell can be used to identify precharge; (3) periodic assessment during ground storage or use can identify a pattern for identifying precharge and evaluating storage needs; and (4) knowing the precharge will allow the user to properly store the batteries.
CASI
Electric Potential; Nickel Hydrogen Batteries; Reversing; Electric Charge; Tests

19990032348 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
MGS 2-Cell CPV NiH2 Batteries
DiStefano, Sal, Jet Propulsion Lab., California Inst. of Tech., USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 581-603; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The Nickel Hydrogen batteries used aboard the Mars Global Surveyor (MGS) is described. The mission itself is briefly described. This is followed by a description of the full electric power subsystem, and the design of the MGS 20 AH cell design. Graphic presentations show characteristics of the battery's performance. In summary, even though the charge control seems to

be well, the method used is not recommended, due to an unexpected increase in pressure observed in flight. The operations have been modified to further minimize overcharge, and the pressure increase is not expected to impact the mission.
CASI
Nickel Hydrogen Batteries; Dynamic Pressure; Operating Temperature; Electric Charge

19990032349 Eagle-Picher Technologies, LLC, Joplin, MO USA
CPV Flight Experience
Cook, William, Eagle-Picher Technologies, LLC, USA; Brill, Jack, Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 605-619; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The experiences in use of the common pressure vessel (CPV) is reviewed in this presentation. The attributes of the CPV, and the company's efforts in the design and usage of the CPV are described. The use of the CPV in the space program is reviewed, and the ongoing programs are summarized. Typical small spacecraft CPV batteries are shown. In summary, the CPV has increased reliability due to fewer parts counts, reduced footprint, and reduced weight. The CPV has been established as a useful component in the satellite market.
CASI
Pressure Vessels; Reliability; Spacecraft Power Supplies; Storage Batteries

19990032350 Naval Surface Warfare Center, Dahlgren, VA USA
Status of SPV/CPV Testing
Brown, Harry, Naval Surface Warfare Center, USA; Hall, Steve, Naval Surface Warfare Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 621-645; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation reviews the status test of Single Pressure Vessel (SPV)/Common Pressure Vessel (CPV) being conducted by the Navy. Slides review the design and tests by NASA, and the Airforce of CPV's. There are 5 different CPV models of CPV's which have been tested or are currently being tested for NASA and the Air Force. The batteries, tests, and results are presented. Graphs show the life cycle voltage, the pressure trend, the discharge/charge profile and the pressure profile for the batteries tested. Descriptions of those CPV batteries are given for those batteries which have been received but have not been tested. The development of the SPV is briefly described, followed by design specification for two packs from NASA and the Air Force. The acceptance test criteria are reviewed, followed by a review of the life cycle test conditions. The trend plots of voltage vs. cycle is given for the two packs. The end of charge, and the end of discharge voltages plots are shown. Plots showing the pressure and recharge vs. cycle are shown. Plots also show the voltage profiles. These plots are shown for both batteries using the SPV design submitted by NASA and the Air Force.
CASI
Electric Batteries; Electric Potential; Pressure Vessels; Acceptability; Performance Tests; Charging; Service Life

19990032351 Eagle-Picher Technologies, LLC, Joplin, MO USA
Nickel-Hydrogen Single Pressure Vessel (SPV) Battery Test Results
Sterz, Steve, Eagle-Picher Technologies, LLC, USA; Parmley, Beth, Eagle-Picher Technologies, LLC, USA; Caldwell, Dwight, Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 647-668; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The single pressure vessel (SPV) battery design is shown. Design specifications are summarized. The test given the Nickel-Hydrogen SPV is summarized: (1) impedance vs depth of discharge, (2) capacity vs discharge rate, (3) mid discharge voltage vs discharge rate, (4) charge retention vs open circuit time, and (5) charge efficiency vs temperature. The results of these tests are shown in charts and graphs. A parallel battery test is described, and the results are reviewed. The conclusions include: (1) SPV battery tests deliver very good, predictable, consistent results compared with extensive IPV (individual pressure vessel) battery experience; (2) same electrochemistry, so proven performance and durability features are retained, (3) SPV advantages are based on the improved producibility, the high reliability, lower cost, and the reduced rate.
CASI
Charge Efficiency; Electric Potential; Pressure Vessel Design; Pressure Vessels; Impedance; Nickel Hydrogen Batteries

19990032352 Eagle-Picher Technologies, LLC, Joplin, MO USA

Lightweight Silver-Hydrogen Cell Design

Coates, Dwaine K., Eagle-Picher Technologies, LLC, USA; Cooper, S. C., Eagle-Picher Technologies, LLC, USA; Bemis, D. P., Eagle-Picher Technologies, LLC, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 669-702; In English; See also 19990032324; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Silver-hydrogen was investigated in the early 1970's as a potential source of energy storage for spacecraft applications and some promising results were obtained. However, development of the silver-hydrogen system was discontinued in favor of the nickel-hydrogen system, which has since become extremely successful in aerospace applications. Problems encountered with the silver-hydrogen system included electrolyte management and silver migration. The silver-hydrogen system is being re-evaluated in light of the developments and advances in technology over the past 20 years. The nickel-hydrogen system has been well developed and engineered and excellent results have been obtained within the past few years with the silver-metal hydride system. The combination of these technologies would yield a battery system capable of competing with lithium-ion on a weight basis. Silver-hydrogen has many advantages over the nickel-hydrogen system, including higher specific energy. This makes reconsideration of the silver-hydrogen system worthwhile. Design evaluation and testing has been performed at the electrode level and boilerplate cell level. Component development has included a radiation grafted three-layer laminate separator, developed by Pall-RAI, which functions well as a silver migration barrier. Flightweight silver-hydrogen cells have been fabricated and are currently undergoing electrical characterization testing. A computer model has been developed to aid in flight cell design analysis and optimization. Cycle life evaluation testing and a thermal performance analysis of the system are also planned.

Author

Computerized Simulation; Electrolytes; Energy Storage; Metal Hydrides; Silver Hydrogen Batteries; Acceptability; Performance Tests

19990032353 NASA Goddard Space Flight Center, Greenbelt, MD USA

Performance of Nickel-Cadmium Batteries on the GOES-1 Series of Weather Satellites

Singhal, Sat P., Computer Sciences Corp., USA; Alsbach, Walter G., Jackson and Tull, Inc., USA; Rao, Gopalakrishna M., NASA Goddard Space Flight Center, USA; The 1998 NASA Aerospace Battery Workshop; February 1999, pp. 703-705; In English; See also 19990032324; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This is an errata from an original paper published in the 1997 NASA Aerospace Battery workshop proceedings. A minor change was made to the second equation on page 98 and table 4 was revised during the final preparation of the paper. These changes were inadvertently left out of the final proceedings. These pages are reproduced in their entirety.

CASI

Electric Batteries; Meteorological Satellites; Nickel Cadmium Batteries

19990032526 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Progress in Photovoltaic System and Component Improvements

Thomas, H. P., Department of Energy, USA; Kroposki, B., Department of Energy, USA; McNutt, P., Department of Energy, USA; Witt, C. E., Department of Energy, USA; Bower, W., Department of Energy, USA; Dec. 31, 1998; 8p; In English; 2nd, USA

Report No.(s): DE98-002967; SAND-98-1538C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Photovoltaic Manufacturing Technology (PVMaT) project is a partnership between the US government (through the US Department of Energy (DOE)) and the PV industry. Part of its purpose is to conduct manufacturing technology research and development to address the issues and opportunities identified by industry to advance photovoltaic (PV) systems and components. The project was initiated in 1990 and has been conducted in several phases to support the evolution of PV industrial manufacturing technology. Early phases of the project stressed PV module manufacturing. Starting with Phase 4A and continuing in Phase 5A, the goals were broadened to include improvement of component efficiency, energy storage and manufacturing and system or component integration to bring together all elements for a PV product. This paper summarizes PV manufacturers' accomplishments in components, system integration, and alternative manufacturing methods. Their approaches have resulted in improved hardware and PV system performance, better system compatibility, and new system capabilities. Results include new products such as Underwriters Laboratories (UL)-listed AC PV modules, modular inverters, and advanced inverter designs that use readily available and standard components. Work planned in Phase 5A1 includes integrated residential and commercial roof-top systems, PV systems with energy storage, and 300-Wac to 4-kWac inverters.

NTIS

Research and Development; Technology Assessment; Photovoltaic Conversion; Manufacturing; Electric Power Supplies; Industries

45
ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

19990028352 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Predictive mathematical modeling of trickling bed biofilters for elucidating mass transfer and kinetic effects
Barton, J. W., Department of Energy, USA; Zhang, X. S., Department of Energy, USA; Klasson, K. T., Department of Energy, USA; Davison, B. H., Department of Energy, USA; Mar. 31, 1998; 23p; In English; 91st; Exhibition of the Air and Waste Management Association, USA
Report No.(s): DE98-004893; ORNL/CP-97102; CONF-980632; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Mathematical models of varying complexity have been proposed in the open literature for describing uptake of volatile organics in trickling bed biofilters. Many simpler descriptions yield relatively accurate solutions, but are limited as predictive tools by numerous assumptions which decrease the utility of the model. Trickle bed operation on the boundary between mass transfer and kinetic limitation regimes serves as one example in which these models may be insufficient. One-dimensional models may also fail to consider important effects/relationships in multiple directions, limiting their usefulness. This paper discusses the use of a predictive, two-dimensional mathematical model to describe microbial uptake, diffusion through a biofilm, and mass transfer of VOCs from gas to liquid. The model is validated by experimental data collected from operating trickle-bed bioreactors designed for removing sparingly soluble gaseous contaminants. Axial and radial (biofilm) concentration profiles are presented, along with validation results. Operation in regimes in which both mass transfer and kinetic factors play significant roles are discussed, along with predictive modeling implications.
NTIS
Bioreactors; Pollution Control; Mathematical Models; Microorganisms; Diffusion; Air Pollution

19990028391 Port of Oakland, CA USA
Supplemental Notice of Preparation of an Environmental Impact Report for the Joint Intermodal Terminal Project, Oakland, Alameda County, California
Jan. 25, 1999; 4p; In English
Report No.(s): AD-A360092; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The Port of Oakland proposes to construct and operate a 150 acre rail-yard terminal to accommodate projected growth in intermodal (transportation mode to transportation mode, i.e.: ship to rail) container distribution from its marine terminals. The project is proposed pursuant to the objectives of the Port of Oakland's "Vision 2000" Program as described in the Final EIS/EIR, Disposal and Reuse of Fleet and Industrial Supply Center, Oakland, VISION 2000 Maritime Development (July 1997). The JIT project is a component of the Vision 2000 Program. The environmental analysis for the JIT will tier off the EIS/EIR mentioned above. An Initial Study has been prepared for the JIT project and identified the potential for the project to have significant impacts primarily related to air quality, traffic, noise and contaminated materials. The Initial Study analysis identified the potential for the project to contribute cumulative air emissions in exceedance of CEQA significance criteria if not mitigated. In addition, the increase in traffic that would occur as a result of the project may potentially contribute to an exceedance in acceptable cumulative traffic volume standards at a local intersection, if not mitigated. Due to the fact that the Navy is currently in the process of investigating contamination on the FISCO site, it is anticipated that more information will be available related to contaminated materials in the future.
DTIC
Rail Transportation; Environment Effects; Contamination

19990028398 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Removal of chlorinated and non-chlorinated alkanes in a trickle-bed biofilter
Klasson, K. T., Department of Energy, USA; Davison, B. H., Department of Energy, USA; Barton, J. W., Department of Energy, USA; Jacobs, J. E., Department of Energy, USA; Jan. 31, 1998; 15p; In English; 91st, USA; Sponsored by Air and Waste Management Association, USA
Report No.(s): DE98-004265; ORNL/CP-96394; CONF-980632; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Increasing restrictions in emissions from a variety of industrial settings demand low cost removal of dilute contaminants in air. Many of these contaminants such as volatile organic components (VOCs) and sulfur compounds are biodegradable and can be removed from air streams via biofiltration. The simplest form of biofiltration consists of compost-based systems. More

advanced systems designed for unique contaminants are biofilters with bioactive structured packing operating in trickle-bed mode. These advanced systems rely on a microbial consortium capable of degrading the contaminants of concern and the consortium usually is isolated or enriched from a more complex microbial mixture. This paper describes the use of a trickle-bed reactor seeded with a microbial consortium enriched from a methanotrophic culture. The microbial consortium has been found to degrade chlorinated alkanes as the sole carbon source. Degradation rates of alkane mixtures are presented for the trickle-bed as well as results from batch cultures experiments designed to study degradation of various chlorinated and non-chlorinated VOCs.
NTIS
Chlorination; Alkanes; Removal

19990028485 NASA Langley Research Center, Hampton, VA USA
Seasonal Ozone Variations in the Isentropic Layer between 330 and 380 K as Observed by SAGE 2: Implications of Extratropical Cross-Tropopause Transport
Wang, Pi-Huan, Science and Technology Corp., USA; Cunnold, Derek M., Georgia Inst. of Tech., USA; Zawodny, Joseph M., NASA Langley Research Center, USA; Pierce, R. Bradley, NASA Langley Research Center, USA; Olson, Jennifer R., NASA Langley Research Center, USA; Kent, Geoffrey S., Science and Technology Corp., USA; Skeens, Kristi, M., Science and Technology Corp., USA; Journal of Geophysical Research; Nov. 27, 1998; ISSN 0148-0227; Volume 103, No. D22, pp. 28,647-28,659; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-96007; NAS1-18941
Report No.(s): Paper-98JD02797; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

To provide observational evidence on the extratropical cross-tropopause transport between the stratosphere and the troposphere via quasi-isentropic processes in the middleworld (the part of the atmosphere in which the isentropic surfaces intersect the tropopause), this report presents an analysis of the seasonal variations of the ozone latitudinal distribution in the isentropic layer between 330 K and 380 K based on the measurements from the Stratospheric Aerosol and Gas Experiment (SAGE) II. The results from SAGE II data analysis are consistent with (1) the buildup of ozone-rich air in the extratropical middleworld through the large-scale descending mass circulation during winter, (2) the spread of ozone-rich air in the isentropic layer from midlatitudes to subtropics via quasi-isentropic transport during spring, (3) significant photochemical ozone removal and the absence of an ozone-rich supply of air to the layer during summer, and (4) air mass exchange between the subtropics and the extratropics during the summer monsoon period. Thus the SAGE II observed ozone seasonal variations in the middleworld are consistent with the existing model calculated annual cycle of the diabatic circulation as well as the conceptual role of the eddy quasi-adiabatic transport in the stratosphere-troposphere exchange reported in the literature.
Author
Atmospheric Circulation; Ozone; Photochemical Reactions; Stratosphere; Temperate Regions; Tropopause; Troposphere; Tropical Regions; Aerosols; Atmospheric Effects; Annual Variations; Middle Atmosphere; Midlatitude Atmosphere

19990028501 Forest Service, Pacifc Northwest Research Station, Portland, OR USA
Air Quality Climate in the Columbia River Basin
Ferguson, S. A., Forest Service, USA; Aug. 1998; 34p; In English
Report No.(s): PB99-119133; FSGTR-PNW-434; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aspects of climate that influence air quality in the Columbia River basin of the Northwestern USA are described. A few, relatively simple, analytical tools were developed to show the spatial and temporal patterns of mean-monthly mixing heights, precipitation scavenging, upper level and surface trajectory winds, and drought that inhibit pollution uptake. Also, potential changes in air quality from the effects of increasing greenhouse gases are discussed.
NTIS
Air Quality; Air Pollution; Columbia River Basin (ID-OR-WA); Climate Change

19990028572 Max-Planck-Inst. fuer Chemie, Mainz, Germany
Intermediate Report on the Contribution of the Max-Planck-Institute for Chemistry Mainz to the ASGAMAGE Project
Rapsomanikis, S., Max-Planck-Inst. fuer Chemie, Germany; Sprung, D., Max-Planck-Inst. fuer Chemie, Germany; Kenntner, T., Max-Planck-Inst. fuer Chemie, Germany; Baumann, M., Max-Planck-Inst. fuer Chemie, Germany; The ASGAMAGE Workshop; 1998, pp. 38-45; In English; See also 19990028569
Contract(s)/Grant(s): CEC-MAS3-CT95-0044; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The determination of dimethyl sulphide (DMS) fluxes was the main interest of this participation in the ASGAMAGE campaigns. After these experiences, we think that in future measurements with mass spectrometers, we will either be provided with some reasonable results by eddy correlation, relaxed eddy accumulation, or inertial dissipation.
CASI
Methyl Compounds; Sulfides; Micrometeorology

19990028573 Colorado Univ., Cooperative Inst. for Research in Environmental Science, Boulder, CO USA
NOAA/ETL Water Vapor Measurements During ASGAMAGE-B
Hare, Jeffrey, Colorado Univ., USA; Fairall, Christopher, National Oceanic and Atmospheric Administration, USA; The ASGAMAGE Workshop; 1998, pp. 46-50; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The National Oceanographic and Atmospheric Administration (NOAA) Environmental Technologies Laboratory (ETL) participated in the ASGAMAGE-B experiments to make direct measurements of the flux of carbon dioxide over the sea. Two additional systems were of interest to ETL: (1) the NOAA Climate Monitoring and Diagnostics Laboratory's closed path gas analyzer, and (2) the Air Resources Laboratory's open path CO2/H2O sensor, which ETL brought to the MPN platform for use in the experiment.
CASI
Carbon Dioxide; Gas Detectors; Water Vapor; Air Water Interactions; Calibrating; Psychrometers; Hygrometers

19990028616 Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC USA
Interagency Workgroup on Air Quality Modeling (IWAQM), Phase 2, Summary Report and Recommendations for Modeling Long Range Transport Impacts
Irwin, J. S., Environmental Protection Agency, USA; Dec. 1998; 168p; In English
Report No.(s): PB99-121089; EPA/454/R-98/019; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This Phase 2 Report is published by the Interagency Workgroup on Air Quality Modeling (IWAQM) in an effort to provide the sponsoring agencies and other interested parties information on appropriate 'off-the-shelf' methods for estimating long range transport impacts of air pollutants on Federal Class I areas.
NTIS
Air Pollution; Meteorological Parameters; Pollution Transport; Environment Models; Air Quality

19990028658 Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC USA
Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds
May 1998; 408p; In English
Report No.(s): PB99-116477; EPA/454/R-98/006; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

This document describes the properties of lead and lead compounds as air pollutants, defines their production and use patterns, identifies source categories of air emissions, and provides lead emission factors. Lead is primarily used in the manufacture of lead-acid batteries, lead alloys, lead oxides in pigments, glass, lead cable coating, and a variety of lead products including ammunition and radiation shielding. Lead is emitted into the atmosphere from mining and smelting; from its use as feedstock in the production of lead alloys, lead compounds and other lead-containing products; from mobile sources; and from combustion sources. In addition to the lead and lead compound sources and emission factor data, information is provided that specifies how individual sources of lead and lead compounds may be tested to quantify air emissions.
NTIS
Lead (Metal); Emission; Air Pollution; Lead Compounds; Contaminants

19990028659 Ec/R, Inc., Chapel Hill, NC USA
Stationary Source Control Techniques Document for Fine Particulate Matter ***Final Report***
Oct. 1998; 256p; In English
Report No.(s): PB99-116493; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This document focuses on fine particulate matter (PM-10 and PM-2.5 - particles with an aerodynamic diameter less than or equal to a nominal 10 microns and 2.5 microns, respectively). Information presented in this document includes background on particulate matter emissions; measurement methods for particulate matter; types of particulate control devices, their operating

principles, design, operation, and control efficiencies; costs and environmental effects of particulate matter control systems; and emerging technologies for particulate matter control.
NTIS
Particulates; Air Pollution; Pollution Control; Control Equipment; Environment Effects

19990028660 Environmental Protection Agency, Science Advisory Board, Washington, DC USA
CASAC Review of the Draft Diesel Health Assessment Document: Review of the Office of Research and Development's Draft Diesel Health Assessment Document by the Clean Air Scientific Advisory Committee (CASAC)
Oct. 1998; 146p; In English
Report No.(s): PB99-116527; EPA/SAB/CASAC-99/001; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Clean Air Scientific Advisory Committee (CASAC) of EPA's Science Advisory Board (SAB), supplemented by expert consultants (together referred to as the 'Panel'), met on May 5-6, 1998 to review the February 1998 draft document, 'Health Assessment Document for Diesel Emissions' (PB98-124308), in a public meeting in Research Triangle Park, NC. An SAB Subcommittee conducted an initial review of the diesel topic in 1990. Subsequently, CASAC reviewed the 1995 draft and found it wanting. At the May 1998 meeting and in written comments provided to EPA staff, the Panel assessed the adequacy of the present draft as an accurate statement of current knowledge about the health effects of diesel exhaust inhaled in the environment, and made numerous suggestions for improvement. The report describes the Panel's views in more detail, and contains its responses to the four specific questions posed by EPA as a charge to the Panel.
NTIS
Diesel Engines; Exhaust Emission; Air Quality; Congressional Reports; Air Pollution; Risk; Public Health

19990028661 Environmental Protection Agency, Residual Risk Subcommittee, Washington, DC USA
SAB Report: Review of the USEPA's Report to Congress on Residual Risk
Sep. 1998; 144p; In English; Portions of this document are not fully legible
Report No.(s): PB99-116535; EPA-SAB-EC-98-013; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Residual Risk Subcommittee of the Science Advisory Board's (SAB) Executive Committee convened in public session on August 3, 1998 to review the U.S. Environmental Protection Agency's draft Residual Risk Report to Congress (Report). The Report describes the strategy methods the Agency will use to assess the risk remaining, (i.e., the residual risk) after maximum achievable control technology (MACT) standards, applicable to emissions sources of hazardous air pollutants (HAPs), have been promulgated under Section 112(d). The SAB endorses the underlying the risk asessment (RA)/risk management (RM) approach described in the Report. The SAB report contains many other specific comments, as well as an appendix containing written comments from individual numbers.
NTIS
Congressional Reports; Risk; Pollution Control; Air Pollution

19990028799 Nevada Univ., Desert Research Inst., Reno, NV USA
Guidance for Using Continuous Monitors in PM2.5 Monitoring Networks
Watson, J. G., Nevada Univ., USA; Chow, J. C., Nevada Univ., USA; Moosmueller, H., Nevada Univ., USA; Green, M., Nevada Univ., USA; Frank, N., Environmental Protection Agency, USA; May 29, 1998; 188p; In English
Contract(s)/Grant(s): CX824291-01-1
Report No.(s): PB99--121600; EPA/454/R-98/012; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This guidance provides a survey of alternatives for continuous in-situ measurements of suspended particles, their chemical components, and their gaseous precursors. Recent and anticipated advances in measurement technology provide reliable and practical instruments for particle quantification over averaging times ranging from minutes to hours. These devices provide instantaneous, telemetered results and can used limited manpower more efficiently than manual, filter based methods. Commonly used continuous particle particle monitors measure inertial mass, mobility, light absorption and light scattering properties of fine particles.
NTIS
Particulates; Air Pollution; Pollution Monitoring; Suspending (Mixing)

19990028838 Environmental Protection Agency, Air Pollution Prevention and Control Div., Research Triangle Park, NC USA
Physical and Chemical Characterization of Fine Particulate from the Combustion of Residual Fuel Oil
Miller, C. A., Environmental Protection Agency, USA; Linak, W. P., Environmental Protection Agency, USA; Wendt, J. O. L., Arizona Univ., USA; 1998; 24p; In English; Air Quality: Mercury, Trace Elements and Particulate Matter, 1-4 Dec. 1998, McLean, VA, USA; Sponsored by Environmental Protection Agency, USA
Contract(s)/Grant(s): EPA-68-D4-0005; EPA Project 7D0222NATX
Report No.(s): PB99-121477; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The paper gives results of research concerned with the characterization of particulate matter (PM) emissions from a practical boiler burning heaving fuel oils. The purpose is to identify hypothetical mechanisms that might relate both the combustion process and the fuel burned to the size-segrated characterization of the fine PM formed, and ultimately to its propensity to cause pulmonary injury. In this initial study, PM samples were taken from the stack of a commercial 732 kW (2.5 MBtu/hr) rated firetube boiler burning four different heavy fuel oils, including two grades and three sulfur contents. Submicron and supermicron particle size distributions (PSDs) were measured using an in-stack cascade impactor, a scanning mobility particle sizer, and an in-situ light scattering system. Size-classified bulk samples were also collected using a high volume dilution sampler. In addition to chemical and physical characterization, these samples were examined for pulmonary toxicity. Finally, EPA Method 5 (total PM) and Method 60 (metal analyses) samples were extracted and analyzed. Measured PSDs show evidence of a submicron accumulation mode between 0.07 and 0.08 micrometer in diameter.
NTIS
Microparticles; Fuel Oils; Combustion Products; Air Pollution; Toxicity; Combustion

19990028842 Department of Energy, Office of Energy Research, Washington, DC USA
Spatial and temporal variations in the atmospheric aerosol optical depth at the ARM CART Site
Nash, T. M., Department of Energy, USA; Cheng, M. D., Department of Energy, USA; Feb. 28, 1998; 16p; In English; 91st; Exhibition of the Air and Waste Management Association, USA
Report No.(s): DE98-005059; ORNL/CP-96847; CONF-980632; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In an effort to better characterize the inputs to radiative transfer models and research-grade global climate simulation models (GCMs) the columnar aerosol loading, measured as the aerosol optical depth (AOD), has been computed for five facilities within the Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) Site. Characterization of the AOD reported here show clear evidence that the spatial and temporal gradient exists at a much finer linear scale than those of the CART site. The annual variations of median AOD are on the order of 0.30 at all five facilities. The Spearman correlation and varimax-rotated PCA indicated the AOD values vary consistently across the CART site. The Northwest corner facility (EF-1) was the single facility that behaved differently from the rest. This sub- GCM grid variation can not be ignored if the model is to be used to accurately predict future climate change.
NTIS
Climate Models; Spatial Resolution; Radiative Transfer; Computation; Climate Change; Spatial Distribution

19990031866 ENVIRON, Novato, CA USA
Hands-on Review of the Urban Airshed Model Including Aerosol Processes (UAM-AERO) ***Final Report***
Yarwood, G., ENVIRON, USA; Wilson, G., ENVIRON, USA; Emery, C., ENVIRON, USA; Jan. 25, 1999; 150p; In English
Report No.(s): PB99-128704; CRC-A-19; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The UAM-AERO is a three-dimensional grid model designed to simulate the formation of particulate matter (PM) during episodic events of high urban PM concentrations. Development of the UAM-AERO began in the early 1990's starting from the EPA's Urban Airshed Model (UAM-IV) which has been extensively used for modeling urban ozone formation. UAM-AERO development was sponsored by the South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB). The objectives of the study were to review the UAM-AERO source code and conduct hand-on diagnostic testing and evaluation of the code function.
NTIS
Aerosols; Emission; Air Pollution; Air Quality; Three Dimensional Models; Photochemical Reactions; Cities

19990031868 National Inst. for Occupational Safety and Health, Cincinnati, OH USA

NIOSH Manual of Analytical Methods (NMAM). Fourth Edition, Supplement 2

Cassinelli, M. E., National Inst. for Occupational Safety and Health, USA; OConnor, P. F., National Inst. for Occupational Safety and Health, USA; Jan. 15, 1998; 518p; In English

Report No.(s): PB99-128621; NIOSH-98-119; No Copyright; Avail: CASI; A22, Hardcopy; A04, Microfiche

This supplement to the NIOSH Manual of Analytical Methods contains twenty new methods, eleven revised methods, twelve corrected methods, and one new chapter. The method finder, contents, and indexes have also been updated to coincide with the changes. The replacement pages are included. The manual is a collection of air, biological, bioaerosol, and bulk analytical methods that NISOH has evaluated. NMAM will be updated as methods are developed, evaluated or revised by NIOSH. These methods are intended to promote accuracy, sensitivity, and specificity in industrial hygiene analyses. The introduction states the purpose and use of the manual. Subsequent sections discuss the quality assurance, sampling, measurements, methods, standards, blanks, blind samples, recovery studies, duplicates, tracking, and reporting. In addition, information to be considered when sampling for airborne contaminants; types and uses of solid sorbents; factors affecting the collection of gases, vapors, and aerosols; sampling strategy and calibration techniques; and samplers is presented.

NTIS

Indoor Air Pollution; Aerosols; Chemical Analysis; Quality Control; Sampling

19990031869 Environmental Protection Agency, National Center for Environmental Assessment, Research Triangle Park, NC USA

Critical Health Issues of Criteria Air Pollutants

Graham, J. A., Environmental Protection Agency, USA; Folinsbee, L., Environmental Protection Agency, USA; Davis, J. M., Environmental Protection Agency, USA; Raub, J., Environmental Protection Agency, USA; Grant, L. D., Environmental Protection Agency, USA; 1998; 70p; In English

Report No.(s): PB99-128407; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This chapter summarizes the key health information on ubiquitous outdoor air pollutants that can cause adverse health effects at current or historical ambient levels in the USA. The Clean Air Act (CAA) of the United States requires that the U.S. Environmental Protection Agency (EPA) identify such pollutants (called criteria pollutants) and set standards (National Ambient Air Quality Standards (NAAQS)) to protect sensitive subpopulations from the adverse effects of these compounds. The criteria pollutants are ozone, nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter (PM), carbon monoxide (CO), and lead. The subsequent sections of this chapter focus on the individual criteria pollutants.

NTIS

Air Pollution; Air Quality; Contaminants; Environment Protection; Particulates; Public Health

19990031870 National Health and Environmental Effects Research Lab., Western Ecology Div., Corvallis, OR USA

Episodic Acidification: Occurrence, Causes and Significance to Aquatic Resources

Wigington, P. J., National Health and Environmental Effects Research Lab., USA; Sep. 1998; 18p; In English; Acidic Deposition, 14-16 Sep. 1998, University Park, PA, USA

Report No.(s): PB99-128373; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Episodic acidification, the short-term decrease of acid neutralizing capacity (ANC) during hydrological events, commonly occurs in streams and lakes around the world. In localities receiving low levels of atmospheric deposition of N and S compounds, acidic episodes (ANC less than or = 0) do not occur unless watershed sources of acidity are present. In regions receiving high levels of atmospheric deposition of acidic N and S compounds, acidic episodes with episodic minimum pH levels less than or = 5 and high inorganic Al concentrations are common. Acidic episodes can have adverse effects on fish populations and other biota in streams. Assessments and evaluations of the aquatic effects of acidic deposition should consider explicitly the occurrences and consequences of episodic acidification.

NTIS

Acidity; Surface Water; Water Quality; Water Resources; Biological Effects

19990031874 Battelle Marine Sciences Lab., Sequim, WA USA

Mycoremediation of Aged Petroleum Hydrocarbon Contaminants in Soil *Final Report*

Thomas, S. A., Battelle Marine Sciences Lab., USA; Becker, P., Battelle Marine Sciences Lab., USA; Pinza, M. R., Battelle Marine Sciences Lab., USA; Word, J. Q., Battelle Marine Sciences Lab., USA; Nov. 1998; 84p; In English

Contract(s)/Grant(s): DE-AC06-76RL-01830

Report No.(s): PB99-121154; PNNL-12056; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Battelle Marine Sciences Laboratory (MSL) and the Washington State Department of Transportation (WSDOT) conducted a 4-month experiment to compare the efficacy of three different biological approaches--mycoremediation, bioremediation, and enhanced bacterial remediation--used under open environmental exposure to treat three excavated, aged-oil-contaminated soils stored at the WSDOT Maintenance Yard, Bellingham, Washington. At the end of the experiment, the results were not conclusive in distinguishing the outcome of the various treatments; none appeared to meet the prescribed criterion for success, namely attainment of the Method A Cleanup Level of total petroleum hydrocarbons (TPH) prescribed by the Washington State Department of Ecology (WSDOE) in Washington Administrative Code (WAC) 173-340 (WAS 1996) and Ecology Publication No. ECY-97-600 (WSDOE 1997) during the allotted time period. However, much useful information and gained by the exercise, and progress was made in understanding the variables that challenge the transition from mesocosm to large-scale deployment of remediation biotechnology. This study also showed that toxicity testing of treated and control soils using native plants and invertebrates can offer valuable information on the suitability of treated substrate for beneficial uses.
NTIS
Hydrocarbons; Biodegradation; Soils; Ecology; Biotechnology; Soil Pollution

19990031892 Department of Energy, Office of Energy Research, Washington, DC USA
Wide-band heterodyne receiver development for effluent measurements
Hutchinson, D. P., Department of Energy, USA; Richards, R. K., Department of Energy, USA; Simpson, M. L., Department of Energy, USA; Bennett, C. A., Department of Energy, USA; Liu, H. C., Department of Energy, USA; May 31, 1998; 12p; In English; 5th; Chemical analysis by laser interrogation of proliferation effluents (CALIOPE), USA
Report No.(s): DE98-005581; ORNL/CP-98092; CONF-980562; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Oak Ridge National Laboratory (ORNL) has been developing advanced infrared heterodyne receivers for plasma diagnostics in fusion reactors for over 20 years. Given typical atmospheric line widths of approximately 3 GHz, a CO2 (or isotope) laser local oscillator with an average line spacing of 50 GHz, and an MCT detector, only chemical species whose absorptions fall directly on top of laser lines can be measured. Thus, with traditional narrow-band heterodyne radiometry, much of the LWIR spectrum is missed and the less complex direct detection DIAL has been the preferred technique in remote sensing applications. Progress at the Institute for Microstructural Sciences (IMS) at National Research Council of Canada and at ORNL in wide-band quantum-well infrared photodetectors (QWIPs) and receivers is significantly enhancing the bandwidth capabilities of heterodyne radiometers. ORNL recently made measurements in the lab using QWIPs developed at IMS that demonstrate heterodyne quantum efficiencies of 5% with a heterodyne bandwidth of 7 GHz. The path forward indicates that greater than 10% heterodyne quantum efficiencies and 30-GHz bandwidths are achievable with current QWIP technology. With a chopped, 30-GHz passive heterodyne receiver, a much larger portion of the LWIR spectrum can now be covered. One potential advantage of wide-band heterodyne receivers for effluent measurements is to dramatically reduce the number of laser lines needed to characterize and distinguish multiple chemical species of interest. In this paper, the authors discuss this and other implications of these new technologies to the characterization of effluents using both passive heterodyne radiometry and thermo-luminescence.
NTIS
Heterodyning; Effluents; Radio Receivers; Broadband

19990031939 Versar, Inc., Columbia, MD USA
Maryland Biological Stream Survey: Ecological Assessment of Non-Tidal Streams Sampled in 1996
Roth, N. E., Versar, Inc., USA; Southerland, M. T., Versar, Inc., USA; Chaillou, J. C., Versar, Inc., USA; Wilson, W. T., Post, Buckley, Schuh and Jernigan, Inc., USA; Heimbuch, D. G., Post, Buckley, Schuh and Jernigan, Inc., USA; October 1998; 196p; In English
Report No.(s): PB99--122913; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The report summarizes results from the second of three years of sampling for the first round of the statewide Maryland Biological Stream Survey (MBSS or the Survey) and provides an update on the program's progress in assessing the condition of Maryland's non-tidal streams. Supported and led by the Maryland Department of Natural Resources (MDNR), the MBSS is a comprehensive program to assess the status of biological resources in Maryland's non-tidal streams; quantify the extent to which acidic deposition has affected or may be affecting critical biological resources in the state; examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams; establish a benchmark for long-term monitoring of trends in these resources; and target future local-scale assessments and mitigation measures needed to restore degraded biological resources.
NTIS
Environmental Surveys; Streams; Acidity; Deposition; Physical Chemistry; Sampling; Surveys; Water

19990031956 Department of Energy, Washington, DC USA

Molecular recognition in gas sensing: Results from acoustic wave and in-situ FTIR measurements

Hierlemann, A., Department of Energy, USA; Ricco, A. J., Department of Energy, USA; Bodenhoefer, K., Department of Energy, USA; Goepel, W., Department of Energy, USA; Jun. 30, 1998; 4p; In English; Solid state sensor and actuator, 1998, USA

Report No.(s): DE98-005522; SAND-98-1207C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Surface acoustic wave (SAW) measurements were combined with direct, in-situ molecular spectroscopy to understand the interactions of surface-confined sensing films with gas-phase analytes. This was accomplished by collecting Fourier-transform infrared external-reflectance spectra (FTIR-ERS) on operating SAW devices during dosing of their specifically coated surfaces with key analytes.

NTIS

Gas Analysis; Molecular Gases; Molecular Spectroscopy; Sound Waves

19990031960 Eastern Research Group, Inc., Morrisville, NC USA

Technical Assistance Document for Sampling and Analysis of Ozone Precursors

Bursey, J., Eastern Research Group, Inc., USA; Dayton, D. P., Eastern Research Group, Inc., USA; Sep. 30, 1998; 506p; In English

Contract(s)/Grant(s): 68-D4-0022

Report No.(s): PB99--124034; NERL-RTP-0-584; EPA/600/R-98/161; No Copyright; Avail: CASI; A22, Hardcopy; A04, Microfiche

The Technical Assistance Document for Sampling and Analysis of Ozone Precursors was originally issued in 1991 and provided guidance to those responsible for establishing and operating Photochemical Assessment Monitoring Stations (PAMS). The current revision is a major expansion and update of the entire document necessitated by advances in measurement technology of the PAMS target compounds. The guidance in the manual provides detailed technical information to regional, state and local air monitoring organizations on sampling and analytical methodology for the PAMS volatile organic compounds (VOCs), total non-methane organic compounds (TNMOCs) and selected carbonyl compounds (formaldehyde, acetaldehyde and acetone). Methodology for measurement of NOx is covered, in addition to a discussion of issues associated with measurement of total reactive oxides of nitrogen (NO(y)). Guidance on meteorological monitoring is also included.

NTIS

Ozone; Chemical Analysis; Sampling; Air Pollution

19990031967 California Univ., Dept.of Land, Air, and Water Resources, Davis, CA USA

Mapping Northern Exposure With POLDER: Application for Circumpolar Methane Exchange *Final Report*

Ustin, Susan L., California Univ., USA; Dec. 10, 1998; 15p; In English

Contract(s)/Grant(s): NCC2-5134; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Three images types from POLDER airborne imagery, nadir looking multi-spectral bands, multiple view-angle images of the red band, and combined datasets, were used to classify land cover types at the NASA southern BOREAS study site in SASkatchewan, Canada. We found that combining multiple view-angle imagery with nadir viewing multi-spectral bands provided the greatest accuracy and discrimination of the largest number of inundated and non-inundated land cover classes. While the nadir looking multi-spectral band data correctly separated open water from other land cover classes it did not separate the inundated vegetated regions that define boreal wetlands. Multiple view-angle data could separate two upland vegetation types and open water but only one inundated vegetation type.

Author

Methane; Imagery; Wetlands

19990031988 Department of Energy, Office of Energy Research, Washington, DC USA

Forest-Atmospheric Carbon Transfer and Storage-2(FACTS-2: Aspen FACE project)

Karnosky, D. F., Department of Energy, USA; Pregitzer, K., Department of Energy, USA; Hendrey, G., Department of Energy, USA; Isebrands, J. G., Department of Energy, USA; Feb. 28, 1998; 11p; In English

Report No.(s): DE98-004421; BNL-65308; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The FACTS-2 (Aspen FACE) infrastructure including 12 FACE rings, a central control facility, a central CO2 and O3 receiving and storage area, a central O3 generation system, and a dispensing system for CO2 and O3 was completed in 1997. The FACE rings were planted with over 10,000 plants (aspen, birch and maple). The entire system was thoroughly tested for both CO2 and O3 and was shown to be effective in delivering elevated CO2 and/or O3 on demand and at predetermined set points.

NTIS

Biological Effects; Air Pollution; Forests; Carbon; Integrated Mission Control Center; Ground Based Control

19990031989 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
HEPA filter jointer
Hill, D., Department of Energy, USA; Martinez, H. E., Department of Energy, USA; Feb. 28, 1998; 38p; In English
Report No.(s): DE98-004420; LA-13407-MS; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A HEPA filter jointer system was created to remove nitrate contaminated wood from the wooden frames of HEPA filters that are stored at the Rocky Flats Plant. A commercial jointer was chosen to remove the nitrated wood. The chips from the wood removal process are in the right form for caustic washing. The jointer was automated for safety and ease of operation. The HEPA filters are prepared for jointing by countersinking the nails with a modified air hammer. The equipment, computer program, and tests are described in this report.
NTIS
Fabrication; Air Pollution; Pollution Control; Air Filters; Contamination

19990032032 Pacific Environmental Services, Inc., Herndon, VA USA
Investigation of Alternative Means for Demonstrating Compliance with the Part 503 Total Hydrocarbon Operational Standards
August 1998; 232p; In English
Contract(s)/Grant(s): EPA-68D20162
Report No.(s): PB99--123457; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The purposes of this study were: (1) to determine if there is a relationship between the concentrations of carbon monoxide (CO) and unburned organic matter (THC) in the exit gas from sewage sludge incinerators; (2) To measure the concentration of THC in the exit gas from 'well operated' sewage sludge incinerators; (3) to measure the concentrations of polychlorinated dibenzodioxins (PCDD) and polychlorinated dibezofurans (PCDF) in the exit gas from sewage sludge incinerators; (4) to study the relationship between incinerator operating conditions (including final hearth temperature) and exit gas THC concentration.
NTIS
Pollution Control; Incinerators; Hydrocarbons; Alternatives; Air Pollution

19990032033 Geological Survey, Water Resources Div., Richmond, VA USA
Selected Heavy Metals and Other Constituents in Soil and Stormwater Runoff at the Interstate 95 Interchange near Atlee, Virginia, *Apr. 1993 - May 1997*
Speiran, G. K., Geological Survey, USA; 1998; 50p; In English
Report No.(s): PB99--122988; USGS/WRI-98-4115; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Concentrations of the heavy metals copper, lead, and zinc, and other constituents, were measured in soil and runoff before and after construction of a stormwater detention basin at the Interstate 95--State Route 656 interchange near Atlee, VA., from April 1993 through May 1997. The spatial and vertical distribution of heavy metals in soil indicate that the paved traffic lanes of the interstate highway are a source of the metals. Concentrations of the metals in soil decrease with increasing soil depth below the ground surface and with increasing distance from the highway lanes. of the three metals for which samples were analyzed, lead was generally present at the greatest concentration, and copper was at the lowest concentration in the soil.
NTIS
Water Runoff; Highways; Heavy Elements; Soil Pollution; Waste Water

19990032043 Sonoma Technology, Inc., Petaluma, CA USA
Development of Gas-Phase Chemistry, Secondary Organic Aerosol, and Aqueous-Phase Chemistry Modules for PM Modeling *Final Report*
Strader, R., Carnegie-Mellon Univ., USA; Gurciullo, C. S., Carnegie-Mellon Univ., USA; Pandis, S. N., Carnegie-Mellon Univ., USA; Kumar, N., Sonoma Technology, Inc., USA; Lurmann, F. W., Sonoma Technology, Inc., USA; Oct. 30, 1998; 132p; In English
Report No.(s): PB99-128738; STI-997510-1822-FR; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Coordinating Research Council (CRC) is sponsoring a multi-phase study to develop improved air quality models for particulate matter (PM). Improved urban and regional scale PM air quality models are needed to develop reliable emission control strategies for areas that exceed the National Ambient Air Quality Standards (NAAQS) for PM-2.5 and PM-10, and for National Parks and other Class I areas with impaired visibility. This report describes the development and implementation of two process modules for PM models. These particular process modules are needed to simulate secondary aerosol species, which are often the dominate portion of PM-2.5 mass. The first module simulates the gas-phase atmospheric chemistry of the VOC/NOx/SO2/ozone system and the formation of secondary organic aerosols. The module also simulates the formation of inorganic species, including

sulfuric acid and nitric acid, that form important aerosol species: sulfate and nitrate; The second module simulates the aqueous-phase chemistry in fogs and clouds. This chemistry primarily enhances SO2 oxidation rates and leads to enhanced sulfate aerosol concentrations.
NTIS
Atmospheric Chemistry; Pollution Monitoring; Computerized Simulation; Particulates; Organic Compounds; Chemical Analysis; Air Quality; Environment Models

19990032141 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Clean cities ozone air quality attainment and maintenance strategies that employ alternative fuel vehicles, with special emphasis on natural gas and propane
Santini, D. J., Department of Energy, USA; Saricks, C. L., Department of Energy, USA; Aug. 4, 1998; 17p; In English; Alternative Transportation Fuels and Air Quality, USA; Sponsored by Transportation Research Board, USA
Report No.(s): DE98-058857; ANL/ES/CP-97092; CONF-980835; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Air quality administrators across the nation are coming under greater pressure to find new strategies for further reducing automotive generated non- methane hydrocarbon (NMHC) and nitrogen oxide (NOx) emissions. The US Environmental Protection Agency (EPA) has established stringent emission reduction requirements for ozone non-attainment areas that have driven the vehicle industry to engineer vehicles meeting dramatically tightened standards. This paper describes an interim method for including alternative-fueled vehicles (AFVs) in the mix of strategies to achieve local and regional improvements in ozone air quality. This method could be used until EPA can develop the Mobile series of emissions estimation models to include AFVs and until such time that detailed work on AFV emissions totals by air quality planners and emissions inventory builders is warranted. The paper first describes the challenges confronting almost every effort to include AFVs in targeted emissions reduction programs, but points out that within these challenges resides an opportunity. Next, it discusses some basic relationships in the formation of ambient ozone from precursor emissions. It then describes several of the salient provisions of EPA's new voluntary emissions initiative, which is called the Voluntary Mobile Source Emissions Reduction Program (VMEP). Recent emissions test data comparing gaseous-fuel light-duty AFVs with their gasoline-fueled counterparts is examined to estimate percent emissions reductions achievable with CNG and LPG vehicles. Examples of calculated MOBILE5b emission rates that would be used for summer ozone season planning purposes by an individual Air Quality Control Region (AQCR) are provided. A method is suggested for employing these data to compute appropriate voluntary emission reduction credits where such (lighter) AFVs would be acquired. It also points out, but does not quantify, the substantial reduction credits potentially achievable by substituting gaseous-fueled for gasoline-fueled heavy- duty vehicles. Finally, it raises and expands on the relevance of AFVs and their deployment to some other provisions embedded in EPA's current guidance for implementing 1-hour NAAQS--standards which currently remain in effect--as tools to provide immediate reductions in ozone, without waiting for promised future clean technologies.
NTIS
Air Quality; Air Pollution; Automobiles; Gaseous Fuels; Environment Protection; Cities; Substitutes

19990032176 Department of Energy, Washington, DC USA
Data management implementation plan for the Bear Creek Valley treatability study, Phase 2, hydraulic performance testing, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee
Dec. 31, 1997; 41p; In English
Report No.(s): DE98-005211; Y/ER-299; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The overall objective of the Bear Creek Valley treatability study is to provide site-specific data defining potential treatment technologies applicable to contaminated groundwater and surface water. The ultimate goal of this effort is to install a treatment system that will remove uranium, technetium, nitrate, and several metals from groundwater before it reaches Bear Creek. This project, the Bear Creek Valley treatability study Phase 2 hydraulic performance testing, directly supports the Bear Creek Valley Feasibility Study. Specific project objectives include (1) installing monitoring and extraction wells, (2) installing a groundwater extraction trench, (3) performing pumping tests of the extraction wells and trench, (4) determining hydraulic gradients, and (5) collecting water quality parameters. The primary purpose of environmental data management is to provide a system for generating and maintaining technically defensible data. to meet current regulatory requirements for the Environmental Restoration Program, complete documentation of the information flow must be established. to do so, each step in the data management process (collection, management, storage, and analysis) must be adequately planned and documented. This document will serve to identify data

management procedures, expected data types and flow, and roles and responsibilities for all data management activities associated with this project.
NTIS
Data Management; Performance Tests; Environment Management; Management Analysis; Management Methods

19990032192 Department of Energy, Washington, DC USA
Integrated chemiresistor and work function microsensor array with carbon black/polymer composite materials
Domansky, K., Department of Energy, USA; Zapf, V. S., Department of Energy, USA; Grate, J. W., Department of Energy, USA; Ricco, A. J., Department of Energy, USA; Yelton, W. G., Department of Energy, USA; May 31, 1998; 6p; In English; Solid state sensor and actuator, 1998, USA
Report No.(s): DE98-005464; SAND-98-1130C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An array of chemically-sensitive field-effect transistors (CHEMFETs) that measure both work function and bulk resistance changes in thin films was used to detect volatile organic compounds. Carbon black/organic polymer composite films were deposited onto the CHEMFETs using an automated microdispensing method.
NTIS
Work Functions; Arrays; Carbon; Organic Compounds; Field Effect Transistors

19990032202 Battelle Columbus Labs., OH USA
Verification Testing of Advanced Environmental Monitoring Systems
Kelly, T. J., Battelle Columbus Labs., USA; Riggs, K. B., Battelle Columbus Labs., USA; Fuerst, R. G., Battelle Columbus Labs., USA; 1999; 10p; In English
Contract(s)/Grant(s): CR-826215
Report No.(s): PB99--126849; EPA/600/A-98/146; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper describes the Advanced Monitoring Systems (AMS) pilot project, one of 12 pilots comprising the U.S. EPA's Environmental Technology Verification (ETV) program. The aim of ETV is to promote the acceptance of environmental technologies in the marketplace, through objective third-party verification of technology performance.
NTIS
Pollution Monitoring; Environmental Monitoring; Proving; Air Pollution; Technology Utilization

19990032249 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Guide to the emissions certification procedures for alternative fuel aftermarket conversions
Jan. 31, 1998; 71p; In English
Report No.(s): DE98-005092; NREL/TP-540-22757; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Emissions certification is still relatively new to the aftermarket vehicle conversion industry. Many in the industry think that as soon as a vehicle is converted to operate on compressed natural gas (CNG) or liquefied petroleum gas (LFG), it automatically runs as clean as or cleaner than it did on the conventional fuel. However, recent studies have shown that aftermarket conversions may not always reduce emissions. to achieve emissions benefits, the conversion equipment must be designed and calibrated specifically for the engine and emissions control system on which it has been installed, and the installation and setup must be performed so as to not adversely affect the vehicle's original emissions performance. The reason for certification, then, is to ensure that these criteria are met, that the vehicle continues to perform properly, and that it continues to satisfy all appropriate emissions standards throughout its useful life. The authors have prepared this guide to help equipment manufacturers, distributors, and installers understand the emissions certification process for aftermarket conversions. The guide gives an overview of the certification requirements established by the US EPA and by the state of California.
NTIS
Exhaust Emission; Certification; Fuel Combustion; Motor Vehicles

19990032259 ENVIRON, Novato, CA USA
Analysis of Data from the 1995 NARSTO-Northeast Air Quality Study, Volume 1, Data Validation and Statistical Summaries of Routine Data *Final Report*
Stoeckenius, T., ENVIRON, USA; Yarwood, G., ENVIRON, USA; Shepard, S., ENVIRON, USA; Taylor, A., ENVIRON, USA; Lee, K., ENVIRON, USA; Dec. 30, 1998; 190p; In English
Report No.(s): PB99--121006; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

High ozone concentrations in the Northeast (NE) are the result of a complex interplay between precursor emissions and meteorological conditions. A major field data collection program was undertaken in the NE U.S. under the auspices of NARSTO-NE. The study are included all of New England and stretches as far west as Ohio and as far south as southern Virginia. An extensive data base of routine and supplement surface and upper-air meteorological and air quality observations was compiled by this program. These data represent a valuable resource for the analysis of factors influencing ozone formation in the NE U.S. In this study, the extensive NARSTO-NE data were reviewed and summarized with particular emphasis on the validation and analysis of the routine speciated hydrocarbon measurements made at 20 Photochemical Assessment Monitoring Station (PAMS) sites located between the Washington, DC area and Cape Elizabeth on the coast of Maine.
NTIS
Ozone; Photochemical Reactions; Pollution Monitoring; Data Processing; Data Acquisition; Gas Composition; Meteorological Parameters; Air Pollution

19990032285 NASA Langley Research Center, Hampton, VA USA
Seasonal Evolution of Rossby and Gravity Wave Induced Laminae in Ozonesonde Data Obtained from Wallops Island, Virginia
Pierce, R. Bradley, NASA Langley Research Center, USA; Grant, William B., NASA Langley Research Center, USA; Geophysical Research Letters; Jun. 01, 1998; Volume 25, No. 11, pp. 1859-1862; In English
Report No.(s): Paper-98GL01507; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
A method for evaluating the seasonal evolution of ozone laminae using ozonesonde data is discussed. The method uses the correlation between small-scale ozone and potential temperature variations to distinguish between laminae generated by quasi-isentropic filamentation by Rossby waves and by vertical displacements of material surfaces by gravity waves. Data from Wallops Island, Virginia show that Rossby wave induced ozone laminae are most frequently encountered at Wallops during the winter months near 15 km while statistically significant gravity wave induced laminae occur above 15 km during the early winter and at the tropopause from late winter through early spring.
Author
Gravity Waves; Ozone; Atmospheric Composition; Variations; Atmospheric Temperature

19990032371 Department of Energy, Office of Energy Research, Washington, DC USA
Monitoring, evaluation, reporting, and verification of climate change mitigation projects: Discussion of issues and methodologies and review of existing protocols and guidelines
Vine, E., Department of Energy, USA; Sathaye, J., Department of Energy, USA; Dec. 31, 1997; 191p; In English
Report No.(s): DE98-052311; LBNL-40316; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Because of concerns with the growing threat of global climate change from increasing emissions of greenhouse gases, the US and other countries are implementing, by themselves or in cooperation with one or more other nations (i.e., joint implementation), climate change mitigation projects. These projects will reduce greenhouse gas (GHG) emissions or sequester carbon, and will also result in non-GHG impacts (i.e., environmental, economic, and social impacts). Monitoring, evaluating, reporting, and verifying (MERV) guidelines are needed for these projects in order to accurately determine their net GHG, and other, benefits. Implementation of MERV guidelines is also intended to: (1) increase the reliability of data for estimating GHG benefits; (2) provide real- time data so that mid-course corrections can be made; (3) introduce consistency and transparency across project types and reporters; and (4) enhance the credibility of the projects with stakeholders. In this paper, the authors review the issues and methodologies involved in MERV activities. In addition, they review protocols and guidelines that have been developed for MERV of GHG emissions in the energy and non-energy sectors by governments, nongovernmental organizations, and international agencies. They comment on their relevance and completeness, and identify several topics that future protocols and guidelines need to address, such as (1) establishing a credible baseline; (2) accounting for impacts outside project boundaries through leakage; (3) net GHG reductions and other impacts; (4) precision of measurement; (5) MERV frequency; (6) persistence (sustainability) of savings, emissions reduction, and carbon sequestration; (7) reporting by multiple project participants; (8) verification of GHG reduction credits; (9) uncertainty and risk; (10) institutional capacity in conducting MERV; and (11) the cost of MERV.
NTIS
Pollution Monitoring; Air Pollution; Pollution Control; Evaluation; Climate Change

19990032373 Department of Energy, Washington, DC USA
First report on non-thermal plasma reactor scaling criteria and optimization models
Rosocha, L. A., Department of Energy, USA; Korzekwa, R. A., Department of Energy, USA; Jan. 13, 1998; 18p; In English
Report No.(s): DE98-005309; LA-UR-98-125; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The purpose of SERDP project CP-1038 is to evaluate and develop non-thermal plasma (NTP) reactor technology for Department of Defense (DoD) air emissions control applications. The primary focus is on oxides of nitrogen (NO(x)) and a secondary focus on hazardous air pollutants (HAPs), especially volatile organic compounds (VOCs). Example NO(x) sources are jet engine test cells (JETCs) and diesel engine powered electrical generators. Example VOCs are organic solvents used in painting, paint stripping, and parts cleaning. To design and build NTP reactors that are optimized for particular DoD applications, one must understand the basic decomposition chemistry of the target compound(s) and how the decomposition of a particular chemical species depends on the air emissions stream parameters and the reactor operating parameters. This report is intended to serve as an overview of the subject of reactor scaling and optimization and will discuss the basic decomposition chemistry of nitric oxide (NO) and two representative VOCs, trichloroethylene and carbon tetrachloride, and the connection between the basic plasma chemistry, the target species properties, and the reactor operating parameters (in particular, the operating plasma energy density). System architecture, that is how NTP reactors can be combined or ganged to achieve higher capacity, will also be briefly discussed.
NTIS
Reactor Technology; Plasma Chemistry; Plasma Heating; Optimization; Architecture (Computers); Technology Assessment

19990032395 Environmental Protection Agency, Air Pollution Prevention and Control Div., Research Triangle Park, NC USA
Application of Intelligent Controls in EPA's Combustion Technology Research and Development
Miller, C. A., Environmental Protection Agency, USA; Lemieux, P. M., Environmental Protection Agency, USA; 1998; 8p; In English
Report No.(s): PB99-126500; EPA/600/A-98/138; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The abstract provides a brief description of the work at EPA's to apply artificial intelligence (AI) methods to control certain combustion emissions. In recent years, studies have been conducted to evaluate fuzzy logic and artificial neural networks as means to improve the performance of combustion systems and instrumentation to monitor those systems. A mission of EPA's is the application of new technologies to the problem of preventing and controlling air pollution from combustion sources. One area of interest is the use of AI methods to improve the performance of existing air pollution control technologies, in terms of both operating and economic efficiencies.
NTIS
Artificial Intelligence; Incinerators; Combustion; Air Pollution; Pollution Control

19990032396 Environmental Protection Agency, Air Pollution Prevention and Control Div., Research Triangle Park, NC USA
Use of Intelligent Computational Techniques for the Estimation and Projection of Air Pollutant Emissions
Kimbrough, E. S., Environmental Protection Agency, USA; Mann, C. O., Environmental Protection Agency, USA; 1998; 8p; In English
Report No.(s): PB99-126484; EPA/600/A-98/140; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

EPA is developing a fuzzy logic and/or neural network model for predicting U.S. greenhouse gas emissions from the electric utility sector. The model would be a refinement and modification of the existing Electric Utility Model (EUMOD). Development and testing of the model would use similar data inputs and would follow a testing and validation procedure similar to that used for EUMOD. In this case, the output from the model would be estimated future carbon dioxide (CO2) emissions for each state. CO2 is the most significant greenhouse gas pollutant in the U.S., accounting for about 85% of national greenhouse gas emissions. Currently electric utilities produce about one-third of the national CO2 emissions.
NTIS
Estimating; Forecasting; Artificial Intelligence; Air Pollution; Emission

19990032546 Department of Energy, Washington, DC USA
New meteorological data assimilation model for real-time emergency response
Sugiyama, G., Department of Energy, USA; Chan, S. T., Department of Energy, USA; Sep. 01, 1997; 8p; In English; 9th; Global change studies, USA; Sponsored by American Meteorological Society, USA
Report No.(s): DE98-052195; UCRL-JC-127579; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We are developing a new meteorological data assimilation model for the Atmospheric Release Advisory Capability (ARAC) project at Lawrence Livermore National Laboratory, which provides real-time dose assessments of airborne pollutant releases. The model, ADAPT (Atmospheric Data Assimilation and Parameterization Techniques), builds three-dimensional meteorological fields, which can be used to drive dispersion models or to initialize or evaluate mesoscale models. ADAPT incorporates many new features and substantial improvements over the current ARAC operational models MEDIC/MATHEW, including the use of continuous-terrain variable-resolution grids, the ability to treat assorted meteorological data such as temperatures, pressure, and

relative humidity, and a new algorithm to produce mass-consistent wind fields. In this paper, we describe the main features of the model, current work on a new atmospheric stability parameterization, and show example results.
NTIS
Meteorological Parameters; Assimilation; Real Time Operation; Mathematical Models

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GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see 93 Space Radiation.

19990028499 NASA Goddard Space Flight Center, Greenbelt, MD USA
General Information: Chapman Conference on Magnetospheric Current Systems
Spicer, Daniel S., NASA Goddard Space Flight Center, USA; Curtis, Steven, NASA Goddard Space Flight Center, USA; 1999; 9p; In English; Magnetospheric Current Systems, 11-15 Jan. 1999, Kona, HI, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The goal of this conference is to address recent achievements of observational, computational, theoretical, and modeling studies, and to foster communication among people working with different approaches. Electric current systems play an important role in the energetics of the magnetosphere. This conference will target outstanding issues related to magnetospheric current systems, placing its emphasis on interregional processes and driving mechanisms of current systems.
Author
Conferences; Earth Magnetosphere; Currents; Geomagnetism

19990028511 NASA Ames Research Center, Moffett Field, CA USA
A Multi-Instrument Approach for Characterizing the Vertical Structure of Aerosol Properties: Case Studies in the Pacific Basin Troposphere
Redemann, J., California Univ., USA; Turco, R. P., California Univ., USA; Pueschel, R. F., NASA Ames Research Center, USA; Fenn, M. A., Science Applications International Corp., USA; Browell, E. V., NASA Langley Research Center, USA; Grant, W. B., NASA Langley Research Center, USA; Journal of Geophysical Research; Sep. 27, 1998; ISSN 0148-0227; Volume 103, No. D18, pp. 23,287-23,298; In English
Contract(s)/Grant(s): NSF ATM-96-18425
Report No.(s): Paper-98JD02005; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

During February/March 1994, a series of aircraft-based aerosol measurements were carried out in the Pacific Basin troposphere using a differential absorption lidar system deployed by NASA Langley, and optical spectrometer probes and a wire-impactor system operated by NASA Ames. A modified Klett inversion algorithm was applied to extract altitude profiles of aerosol backscattering from the IR lidar signal. The algorithm that we have designed for this purpose utilizes the in situ aerosol measurements to normalize the lidar profile at the aircraft altitude and to supply the lidar ratio as a function of height. The lidar-derived aerosol backscattering coefficients were then compared to the backscattering coefficients calculated from the in situ measurements. During several local aircraft descents, we found good agreement between the remote lidar and in situ results for the absolute value of the aerosol backscattering coefficient and its altitude variation only when we allowed for several layers with different aerosol refractive indices. The agreement validates our lidar calibration method and provides an indication of the variation in aerosol refractive index as a function of altitude. Two of the three case studies performed in this paper reveal layers of anthropogenic aerosols transported long distances into the Pacific Basin troposphere. A third case implies the existence of a layer of dustlike aerosol particles in the lower troposphere, most likely of Asian origin.
Author
Aerosols; Backscattering; Optical Radar; Troposphere; Vertical Distribution; Pacific Ocean; Atmospheric General Circulation Models

19990028532 Department of Energy, Office of Energy Research, Washington, DC USA
Reexamination of fault angles predicted by shear localization theory
Rudnicki, J. W., Department of Energy, USA; Olsson, W. A., Department of Energy, USA; Feb. 28, 1998; 12p; In English; 3rd, USA; Meeting sponsored in part by North American Rock Mechanics Society
Report No.(s): DE98-004223; SAND-98-0519C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper reexamines orientations of shear bands (fault angles) predicted by a theory of shear localization as a bifurcation from homogeneous deformation. In contrast to the Coulomb prediction, which does not depend on deviatoric stress state, the angle between the band normal and the least (most compressive) principal stress increases as the deviatoric stress state varies from axisymmetric compression to axisymmetric extension. This variation is consistent with the data of Mogi (1967) on Dunham dolomite for axisymmetric compression, extension and biaxial compression, but the predicted angles are generally less than observed. This discrepancy may be due to anisotropy that develops due to crack growth in preferred orientations. Results from specialized constitutive relations for axisymmetric compression and plane strain that include this anisotropy indicate that it tends to increase the predicted angles. Measurements for a weak, porous sandstone (Castlegate) indicate that the band angle decreases with increasing inelastic compaction that accompanies increasing mean stress. This trend is consistent with the predictions of the theory but, for this rock, the observed angles are less than predicted.
NTIS
Examination; Plane Strain; Geological Faults

19990028533 Department of Energy, Washington, DC USA
Progress on the development of a three-dimensional capability for simulating large-scale complex geologic processes
Argueello, J. G., Department of Energy, USA; Stone, C. M., Department of Energy, USA; Fossum, A. F., Department of Energy, USA; Feb. 28, 1998; 12p; In English; 3rd, USA; Meeting sponsored in part by North American Rock Mechanics Society
Report No.(s): DE98-004222; SAND-97-1018C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Significant progress has been made in developing a three-dimensional capability for predicting the mechanical response of rock over spatial and time scales of geologic interest to the Oil and Gas industry. An Advanced Computational Technology Initiative (ACTI) initiated three years ago to achieve such a computational technology breakthrough has made significant progress towards its goal by adapting and improving the unique advanced quasistatic finite element technology developed by Sandia National Laboratories to the mechanics applications important to exploration and production (E and P). This capability now gives the industry a powerful tool to help reduce risk on prospects, improve pre-project initial reserve estimates, and lower operating costs. Progress to date on this program is reported herein by presenting and discussing the enhancements and adaptations that have been made to the technology, with specific examples to illustrate their use on large E and P geomechanics problems.
NTIS
Geology; Computerized Simulation; Rock Mechanics; Natural Gas Exploration; Three Dimensional Models

19990028557 Academy of Sciences (USSR), Space Research Inst., Moscow, USSR
Dynamics of the Magnetosphere and its Coupling to the Ionosphere on Multiple Scales
Feb. 16, 1999; 103p; In English, 8-13 Feb. 1999, Zvenigorod, Russia
Contract(s)/Grant(s): F61775-99-W-F018
Report No.(s): AD-A360557; EOARD-CSP-99-5018; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Final Proceedings for Dynamics of the Magnetosphere and its Coupling to the Ionosphere on Multiple Scales held during the period 8 February 1999 - 13 February 1999. This is an interdisdplinary conference. Topics include solar-terrestrial interactions, magnetospheric physics, and magnetosphere-ionosphere coupling. Presentations will mainly be from the four-satellite Interball system, including joint studies with the US and Japanese ISTP satellites.
DTIC
Solar Physics; Magnetosphere-Ionosphere Coupling; Earth Magnetosphere; Earth Ionosphere; Conferences

19990028571 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
Measurement of CO2 Fluxes With the IFM During ASGAMAGE
Kohsiek, Wim, Royal Netherlands Meteorological Inst., Netherlands; The ASGAMAGE Workshop; 1998, pp. 33-37; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

In a laboratory study the effect of cross-talk from H2O on CO2 was investigated. It was found that both water layer on the optics and pressure broadening play a role. The second effect was found to be about -1/2 the dilution correction. Using the laboratory results, the ASGAMAGE data was corrected. The final data was structured in three groups, according to the optical filter pair used for calculating the CO2 concentration. No systematic difference between the three groups could be discerned, indicating that no systematic effects of cross-talk are left. The final CO2 flux data show a spread of typically 5* 10(exp -5) gm(exp -2) s(exp -1) and follow the relation of Wanninkhof rather well.
Derived from text
Carbon Dioxide Concentration; Crosstalk; Pressure Broadening; Water

19990028574 Colorado Univ., Cooperative Inst. for Research in Environmental Science, Boulder, CO USA

NOAA/CMDL Contribution to ASGAMAGE-B ***Final Report***

Dissly, Richard W., Colorado Univ., USA; Smith, Jim, Atmospheric Observing Systems, USA; Tans, Pieter P., National Oceanic and Atmospheric Administration, USA; The ASGAMAGE Workshop; 1998, pp. 51-72; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The goal of the group from the National Oceanographic and Atmospheric Administration (NOAA) Climate Monitoring and Diagnostics Laboratory (CMDL) was to utilize a sensitive closed-path analyzer to make direct air-sea flux measurements of CO2. Three different techniques were used to measure CO2 flux: (1) Eddy Correlation, (2) Relaxed eddy accumulation (REA), and vertical gradient (VG). In summary, the three methods used gave sparse flux data. These could not be overlapped in order to intercompare the results.

CASI

Air Water Interactions; Carbon Dioxide; Correlation; Environmental Monitoring

19990028575 Plymouth Marine Lab., UK

Measurements Made During Challenger 129: A Contribution to ASGAMAGE

Nightingale, Phil, Plymouth Marine Lab., UK; Upstill-Goddard, Rob, Newcastle Univ., UK; Malin, Gill, East Anglia Univ., UK; Ho, David, Lamont-Doherty Geological Observatory, USA; Schlosser, Peter, Lamont-Doherty Geological Observatory, USA; Broadgate, Wendy, East Anglia Univ., UK; Sjoeberg, Tristan, Plymouth Marine Lab., UK; The ASGAMAGE Workshop; 1998, pp. 73-78; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The measurement of the gas transfer velocities at sea by using multiple tracers is explored in this presentation. The two tracers, one inert but volatile and the other inert but non-volatile would be released. Two volatile tracers with a large diffusivity contrast i.e., He-3, and SF6 were released to seawater and their concentrations monitored with time as they escaped to the atmosphere at different rates. Using three non-volatile tracers: (1)Bacillus Globigii Var Niger (BG), (2) Rhodamines WT, and (3) Sulpho-G, the transfer data has been used to generate estimates of the transfer velocity from the various combinations of the tracer volatile, and non-volatile pairs.

CASI

Bacillus; Rhodamine; Sea Water; Tracers; Schmidt Number; Air Water Interactions; Gas Exchange; Velocity Measurement

19990028576 Southampton Univ., Dept. of Oceanography, UK

Air-Sea Exchange Processes and their Remote Measurement by the Southampton University Department of Oceanography

Graham, Angus, Southampton Univ., UK; Woolf, David, Southampton Univ., UK; The ASGAMAGE Workshop; 1998, pp. 79-94; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

This report contains abstracts of two talks given as part of a meeting called in September 1997, to review progress of partners in ASGAMAGE, an international program of experimental research in to air-sea gas fluxes. The objectives and methods employed by researchers at Southampton University Department of Oceanography are fully described in the report. The analysis is still underway, so results given are preliminary. The second report is an account of progress of the thermal imaging techniques. The acoustic work that has been conducted, in which surface waves and the bubbles generated as they break have been imaged, is also described.

Derived from text

Air Water Interactions; Bubbles; Gas Spectroscopy; Thermal Mapping; Surface Waves

19990028577 Physics and Electronics Lab. TNO, The Hague, Netherlands

CO2 Gas Concentrations, Gradients and Air-Sea Exchange During ASGAMAGE (TNO-FEL Results)

Kunz, Gerard J., Physics and Electronics Lab. TNO, Netherlands; deLeeuw, Gerrit, Physics and Electronics Lab. TNO, Netherlands; Larsen, Soren E., Risoe National Lab., Denmark; Hansen, Finn A., Risoe National Lab., Denmark; Lund, Soren W., Risoe National Lab., Denmark; The ASGAMAGE Workshop; 1998, pp. 95-104; In English; See also 19990028569

Contract(s)/Grant(s): CEC-MAS3-CT95-0044; A95/KM/785; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

The ASGAMAGE experiments were coordinated by the Royal Netherlands Meteorological Institute from the Meetpost Noordwijk MPN) a research platform in the North Sea 9 km off the Dutch coast. The atmospheric concentration of CO2 was mea-

sured at four different levels and the CO2 concentration (fugacity) was measured in the sea using an equilibrator system. The key instrument a LI-COR 7272 differential, non-dispersive, infrared gas analyzer was calibrated using four standard gases. The performance of the instrument was verified every 2 hours using three reference gases. Air-sea fluxes of CO2 were calculated using the gas transfer rate and the solubility. In addition, fluxes of CO2 were estimated from atmospheric gradients, the wind speed and the bulk transfer coefficient for water vapor. the dry air atmospheric mole fraction of CO2 during on shore wind (maritime conditions in October/November 1996 was 359 + or - 2.5 ppm. Air from rural and industrial areas could clearly be distinguished from maritime air during periods of off shore winds. In those periods, the CO2 mole fraction increased by about 25 pm and 80 ppm respectively. Values of P(sub CO2) in the water varied slowly from about 41.0 Pa to about 48.5 Pa with tidal variation of about 1.5 Pa. CO2 fluxes calculated from the gas concentration gradients in the atmosphere varied in the range from 0.00 mg/square meter to 0.02 mg/ square meter + or - 50 %. The fluxes obtained with the two methods do not correlate. This may be explained from the time required to equilibrate the partial pressure difference between the sea and the overlaying air or from the low SNR in the data from the air gradient method.
Author
Air Water Interactions; Atmospheric Composition; Calibrating; Carbon Dioxide; Carbon Dioxide Concentration; North Sea; Wind (Meteorology)

19990028578 University Coll., Dept. of Oceanography, Galway, Ireland
Measurements of Total Gas Saturation, Bubble Population and Acoustic Scattering During ASGAMAGE
Bowyer, Peter, University Coll., Ireland; The ASGAMAGE Workshop; 1998, pp. 105-108; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

Measurements were made during ASGAMAGE A and B from two University College Galway (UCG) total gas meters. The results from ASGAMAGE A show a steady decreasing saturation, possibly biological in origin. The data from ASGAMAGE B is shown, noting the difference between the atmospheric pressure and the total gas tension, the low air pressure, and the the rate of change in gas concentration in the water. Acoustic measurements were also taken during ASGAMAGE A, to measure the increased scattering from the breaking waves beneath the surface. Hydrographic measurements were also taken. Bubble spectra measurements were also taken.
CASI
Atmospheric Pressure; Bubbles; Gas Pressure; Hydrography; Surface Waves; Water Waves

19990028579 Bedford Inst. of Oceanography, Dartmouth, Nova Scotia Canada
Data Workshop Report From BIO-ASGAMAGE-B
Anderson, Robert J., Bedford Inst. of Oceanography, Canada; Smith, Stuart D., Bedford Inst. of Oceanography, Canada; The ASGAMAGE Workshop; 1998, pp. 109-115; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

Eddy fluxes of momentum, heat water vapor and CO2 have been calculated from time series data logged with the Bedford Institute of Oceanography (BIO) system using the BIO Kaijo Denki DAT-300 sonic anemometer-thermometer, microbead thermistor probes and an ERC Lyman-alpha (ultraviolet absorption) H2O sensor. Data from the Aspirated KNMI IFM IR H2O and CO2 and KNMI Lyman-Alpha (ultraviolet) H20 sensors, KNMI sea surface temperature and wave wire, Oak Ridge IR CO2 and H20 sensor were also logged on the BIO system. Problems with some of the sensors were reported. Preliminary results were reported on CO2 flux, and wind stress evaporation and heat flux coefficients.
CASI
Carbon Dioxide; Evaporation; Heat Flux; Ocean Surface; Oceanography; Surface Waves; Wind Shear; Time Series Analysis

19990028580 Risoe National Lab., Wind Energy and Atmospheric Physics, Roskilde, Denmark
Experimental and Modeling Study of Air-Sea Exchange of Carbon Dioxide
Larsen, Soren E., Risoe National Lab., Denmark; Hansen, Finn A., Risoe National Lab., Denmark; Kjeld, J. F., Risoe National Lab., Denmark; Lund, Soren W., Risoe National Lab., Denmark; Kunz, Gerard J., Physics and Electronics Lab. TNO, Netherlands; deLeeuw, Gerrit, Physics and Electronics Lab. TNO, Netherlands; The ASGAMAGE Workshop; 1998, pp. 116-123; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

Air sea exchange of slowly dissolving gases is still associated with some uncertainties. The transfer-velocity relation based on previous studies offer integration of many data sets, although with substantial scatter. However the small transfer rates implied by these relations indicate that in the natural environment fluxes and concentrations will often not be in equilibrium, implicitly

assuming when employing the transfer velocity relations. It is therefore important to compare simultaneous flux estimates by different estimation methods.
Author
Air Water Interactions; Carbon Dioxide; Dissolving; Flux Quantization; Micrometeorology; Momentum; Heat Flux; Water Vapor

19990028581 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
The Effect of Long Measurement Times on Flux Measurements at Sea
Oost, Wiebe A., Royal Netherlands Meteorological Inst., Netherlands; The ASGAMAGE Workshop; 1998, pp. 124-126; In English; See also 19990028569; Copyright; Avail: Issuing Activity (Royal Netherlands Meteorological Inst., Postbus 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, Netherlands), Hardcopy, Microfiche

In the KNMI eddy correlation measurements of the CO2 flux during ASGAMAGE many correction factors have been applied, but the resulting values for the transfer velocity, K, are still something like a factor two times higher than the Wannikhof curve, which in itself is already some 50% higher than the other parameterization in general use, (i.e., the Liss-Merlivat relation). The ASGAMAGE differential tracer results from the ”Challenger”, on the other hand, confirm the Liss-Merlivat curve. Both techniques, eddy correlation and differential tracer, have their weak and strong points, but both are sufficiently well founded and the experiments have been performed sufficiently carefully to expect a much better correspondence.
Author
Carbon Dioxide; Correction; Heat Transfer; Velocity; Air Water Interactions

19990028610 NASA Goddard Space Flight Center, Greenbelt, MD USA
Persistence of the Lower Stratospheric Polar Vortices
Waugh, Darryn W., Johns Hopkins Univ., USA; Randel, William J., National Center for Atmospheric Research, USA; Pawson, Steven, NASA Goddard Space Flight Center, USA; Newman, Paul A., NASA Goddard Space Flight Center, USA; Nash, Eric R., NASA Goddard Space Flight Center, USA; [1999]; In English
Contract(s)/Grant(s): NAG1-2043; NAG5-7361; NAGw-18181; NAGw-16215; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The persistence of the Arctic and Antarctic lower stratospheric vortices is examined over the period 1958 to 1998. Three different vortex-following diagnostics (two using potential vorticity and one based solely on the zonal winds) are compared, and shown to give very similar results for the break up date. The variability in the timing of the breakup of each vortex is qualitatively the same: there are large interannual variations together with smaller decadal-scale variations and there is a significant increase in the persistence since the mid-1980s (all variations are larger for the Arctic vortex). Also, in both hemispheres there is a high correlation between the persistence and the strength and coldness of the spring vortex, with all quantities having the same interannual and decadal variability. However, there is no such correlation between the persistence and the characteristics of the midwinter vortex. In the northern hemisphere there is also a high correlation between the vortex persistence and the upper tropospheric/lower stratospheric eddy heat flux averaged over the two months prior to the breakup. This indicates that the variability in the wave activity entering the stratosphere over late-winter to early-spring plays a key role in the variability of the vortex persistence (and spring polar temperatures) on both interannual and decadal time scales. However, the decadal variation in the Arctic vortex coldness and persistence for the 1990’s falls outside the range of natural variability, while this is not the case for the eddy heat flux. This suggests that the recent increase in vortex persistence is not due solely to changes in the wave activity entering the stratosphere.
Author
Antarctic Regions; Arctic Regions; Vortices; Periodic Variations; Stratosphere; Variability

19990031964 NASA Goddard Space Flight Center, Greenbelt, MD USA
Large-Scale Dynamics of the Magnetospheric Boundary: Comparisons between Global MHD Simulation Results and ISTP Observations
Berchem, J., California Univ., USA; Raeder, J., California Univ., USA; Ashour-Abdalla, M., California Univ., USA; Frank, L. A., Iowa Univ., USA; Paterson, W. R., Iowa Univ., USA; Ackerson, K. L., Iowa Univ., USA; Kokubun, S., Nagoya Univ., Japan; Yamamoto, T., Ministry of Education, Science and Culture, Japan; Lepping, R. P., NASA Goddard Space Flight Center, USA; Geospace Mass and Energy Flow: Results from the International Solar-Terrestrial Physics Program; 1998, pp. 247-260; In English
Contract(s)/Grant(s): NAGw-1100; NAGw-4541; NAGw-4543; NAG5-2371
Report No.(s): IGGPP-Publ-4877; GEOPHYSICAL-MONOGRAPH-104; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Understanding the large-scale dynamics of the magnetospheric boundary is an important step towards achieving the ISTP mission's broad objective of assessing the global transport of plasma and energy through the geospace environment. Our approach is based on three-dimensional global magnetohydrodynamic (MHD) simulations of the solar wind-magnetosphere- ionosphere system, and consists of using interplanetary magnetic field (IMF) and plasma parameters measured by solar wind monitors upstream of the bow shock as input to the simulations for predicting the large-scale dynamics of the magnetospheric boundary. The validity of these predictions is tested by comparing local data streams with time series measured by downstream spacecraft crossing the magnetospheric boundary. In this paper, we review results from several case studies which confirm that our MHD model reproduces very well the large-scale motion of the magnetospheric boundary. The first case illustrates the complexity of the magnetic field topology that can occur at the dayside magnetospheric boundary for periods of northward IMF with strong Bx and By components. The second comparison reviewed combines dynamic and topological aspects in an investigation of the evolution of the distant tail at 200 R(sub E) from the Earth.
Author
Magnetohydrodynamics; Interplanetary Magnetic Fields; Boundaries; Magnetic Field Configurations; Data Flow Analysis; Energy Transfer; Time Series Analysis; Solar Wind; Bow Waves

19990032067 NASA Goddard Space Flight Center, Greenbelt, MD USA
Atmospheric Multiple Scattering Effects on GLAS Altimetry, Part 1, Calculations of Single Pulse Bias
Duda, David P., NASA Goddard Space Flight Center, USA; Spinhirne, James D., NASA Goddard Space Flight Center, USA; Eloranta, Edwin W., Wisconsin Univ., USA; IEEE Transactions on Remote Sensing; February 1999; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Estimates of the effect of pulse stretching on satellite laser altimetry in particular the Geoscience Laser Altimeter System (GLAS), by cloud multiple scattering were made from an analytical method and from Monte Carlo calculations. The path delay of the return pulse was found to be largest for low-level clouds with particle radii (3-20 microns). The magnitude of the path delay was affected by several factors including cloud height, cloud optical depth, cloud particle size, particle shape, and receiver field of view. Polar aerosol and Rayleigh scattering usually added less than 1 cm to the overall path delay. Path delay estimates for all cloud conditions would be less if a simple Gaussian fit of the return pulse peak were used to measure the pulse's centroid. However, care must be taken in determining the centroid as factors such as pulse width, surface slope and the fitting method used will affect the estimate. A planned application for laser altimetry is high precision monitoring of the height change of polar ice sheets. In the absence of a correction algorithm, the required GLAS altimetry accuracies will not be achieved unless atmospheric channel information is used to remove profiles that are likely to be heavily contaminated by multiple scattering.
Author
Laser Altimeters; Altimetry; Pulse Duration; Monte Carlo Method; Pulsed Lasers; Rayleigh Scattering

19990032125 Department of Energy, Washington, DC USA
Digital database development and seismic characterization and calibration for the middle east and North Africa
Harris, D., Department of Energy, USA; Mar. 1, 1998; 13p; In English
Report No.(s): DE98-058714; UCRL-CR-130656; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ground truth information was provided to the Lawrence Livermore National Laboratory for experimental discrimination of mine-related explosions from earthquakes. Remotely sensed data, knowledge of regional, geology and tectonics, and other data sets were provided for two distinct projects at LLNL: (1) Detection of recent strip- mining activity using satellite remote sensing by Dr. William Pickles, and (2) Discrimination of mine- related explosions from earthquakes using regional wave form data by Dr. David Harris and Dr. William Walter. The primary contact person at Comell for this activity was Francisco Gomez, a graduate student whose studies focus on the regional geology and tectonics of Morocco. Two visits were made to LLNL by Francisco Gomez during Winter 1996 and Winter 1997, as well as one visit to Comell by Dave Harris during the Summer of 1997.
NTIS
Data Bases; Data Base Management Systems; Seismology; Africa; Middle East; Ground Truth; Remote Sensing

19990032208 NASA Langley Research Center, Hampton, VA USA
Influence of Subpixel Scale Cloud Top Structure on Reflectances from Overcast Stratiform Cloud Layers
Loeb, N. G., Oregon State Univ., USA; Varnai, Tamas, Arizona Univ., USA; Winker, David M., NASA Langley Research Center, USA; Journal of the Atmospheric Sciences; 1998; Volume 55, pp. 2960-2973; In English
Contract(s)/Grant(s): NAG1-1263; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Recent observational studies have shown that satellite retrievals of cloud optical depth based on plane-parallel model theory suffer from systematic biases that depend on viewing geometry, even when observations are restricted to overcast marine stratus

layers, arguably the closest to plane parallel in nature. At moderate to low sun elevations, the plane-parallel model significantly overestimates the reflectance dependence on view angle in the forward-scattering direction but shows a similar dependence in the backscattering direction. Theoretical simulations are performed that show that the likely cause for this discrepancy is because the plane-parallel model assumption does not account for subpixel, scale variations in cloud-top height (i.e., ”cloud bumps”). Monte Carlo simulation, comparing ID model radiances to radiances from overcast cloud field with 1) cloud-top height variation, but constant cloud volume extinction; 2) flat tops but horizontal variations in cloud volume extinction; and 3) variations in both cloud top height and cloud extinction are performed over a approximately equal to 4 km x 4 km domain (roughly the size of an individual GAC AVHRR pixel). The comparisons show that when cloud-top height variations are included, departures from 1D theory are remarkably similar (qualitatively) to those obtained observationally. In contrast, when clouds are assumed flat and only cloud extinction is variable, reflectance differences are much smaller and do not show any view-angle dependence. When both cloud-top height and cloud extinction variations are included, however, large increases in cloud extinction variability can enhance reflectance difference. The reason 3D-1D reflectance differences are more sensitive to cloud-top height variations in the forward-scattering direction (at moderate to low, sun elevations) is because photons leaving the cloud field in that direction experience fewer scattering events (low-order scattering) and are restricted to the topmost portions of the cloud. While reflectance deviations from 1D theory are much larger for bumpy clouds than for flat clouds with variable cloud extinction, differences in cloud albedo are comparable for these two cases.
Author
Cloud Height Indicators; Clouds (Meteorology); Stratus Clouds; Optical Thickness; Advanced Very High Resolution Radiometer; Forward Scattering; Pixels; Cloud Cover; Cloud Physics

19990032294 NASA Langley Research Center, Hampton, VA USA
Atmos/Atlas 3 Infrared Profile Measurements of Clouds in the Tropical and Subtropical Upper Troposphere
Rinsland, C. P., NASA Langley Research Center, USA; Gunson, M. R., Jet Propulsion Lab., California Inst. of Tech., USA; Wang, P.-H., Science and Technology Corp., USA; Arduini, R. F., Science Applications International Corp., USA; Baum, B. A., NASA Langley Research Center, USA; Minnis, P., NASA Langley Research Center, USA; Goldman, A., Denver Univ., USA; Abrams, M. C., ITT Defense and Electronics, USA; Zander, R., Liege Univ., Belgium; Mahieu, E., Liege Univ., Belgium; Salawitch, R. J., Jet Propulsion Lab., California Inst. of Tech., USA; Michelsen, H. A., Harvard Univ., USA; Irions, F. W., Jet Propulsion Lab., California Inst. of Tech., USA; Newchurch, M. J., Alabama Univ., USA; Journal of Quantitative Spectroscoy and Radiative Transfer; 1998; ISSN 0022-4073; Volume 60, No. 5, pp. 903-919; In English; Sponsored in part by the O.S.T.C., Brussels; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Vertical profiles of infrared cirrus extinction have been derived from tropical and subtropical upper tropospheric solar occultation spectra. The measurements were recorded by the Atmospheric Trace Molecule Spectroscopy (ATMOS) Fourier transform spectrometer during the Atmospheric Laboratory for Applications and Sciences (ATLAS) 3 shuttle flight in November 1994. The presence of large numbers of small ice crystals is inferred from the appearance of broad extinction features in the 8-12 micron region. These features were observed near the tropopause and at lower altitudes. Vertical profiles of the ice extinction (/km) in microwindows at 831, 957, and 1204/cm have been retrieved from the spectra and analyzed with a model for randomly oriented spheroidal ice crystals. An area-equivalent spherical radius of 6 gm is estimated from the smallest ice crystals observed in the 8-12 micron region. Direct penetration of clouds into the lower stratosphere is inferred from observations of cloud extinction extending from the upper troposphere to 50 mbar (20 km altitude). Cloud extinction between 3 and 5 micron shows very little wavelength dependence, at least for the cases observed by the ATMOS instrument in the tropics and subtropics during ATLAS 3.
Author
Infrared Radiation; Troposphere; Tropical Regions; Solar Spectra; Space Transportation System Flights; Stratosphere

19990032411 NASA Goddard Space Flight Center, Greenbelt, MD USA
On Geomagnetism and Paleomagnetism
Voorhies, Coerte V., NASA Goddard Space Flight Center, USA; Physics of the Earth and Planetary Interiors; 1998; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A statistical description of Earth’s broad scale, core-source magnetic field has been developed and tested. The description features an expected, or mean, spatial magnetic power spectrum that is neither ”flat” nor ”while” at any depth, but is akin to spectra advanced by Stevenson and McLeod. This multipole spectrum describes the magnetic energy range; it is not steep enough for Gubbins’ magnetic dissipation range. Natural variations of core multipole powers about their mean values are to be expected over geologic time and are described via trial probability distribution functions that neither require nor prohibit magnetic isotropy. The description is thus applicable to core-source dipole and low degree non-dipole fields despite axial dipole anisotropy. The description is combined with main field models of modem satellite and surface geomagnetic measurements to make testable predictions

of: (1) the radius of Earth's core, (2) mean paleomagnetic field intensity, and (3) the mean rates and durations of both dipole power excursions and durable axial dipole reversals. The predicted core radius is 0.7% above the 3480 km seismologic value. The predicted root mean square paleointensity (35.6 mu T) and mean Virtual Axial Dipole Moment (about 6.2 lx 1022 Am(exp 2)) are within the range of various mean paleointensity estimates. The predicted mean rate of dipole power excursions, as defined by an absolute dipole moment less than 20% of the 1980 value, is 9.04/Myr and 14% less than obtained by analysis of a 4 Myr paleointensity record. The predicted mean rate of durable axial dipole reversals (2.26/Myr) is 2.3% more than established by the polarity time-scale for the past 84 Myr. The predicted mean duration of axial dipole reversals (5533 yr) is indistinguishable from an observational value. The accuracy of these predictions demonstrates the power and utility of the description, which is thought to merit further development and testing. It is suggested that strong stable stratification of Earth's uppermost outer core leads to a geologically long interval of no dipole reversals and a very nearly axisymmetric field outside the core. Statistical descriptions of other planetary magnetic fields are outlined.
Author
Dipole Moments; Geochronology; Geomagnetism; Magnetic Fields; Magnetic Flux; Paleomagnetism; Planetary Magnetic Fields; Earth Core; Geophysical Fluids; Magnetic Poles; Core-Mantle Boundary

19990032507 Department of Energy, Office of Energy Research, Washington, DC USA
Towards quantifying mesoscale flows in the troposphere using Raman lidar and sondes
Demoz, B., Department of Energy, USA; Evans, K., Department of Energy, USA; Starr, D., Department of Energy, USA; Mar. 31, 1998; 6p; In English; 8th; Atmospheric Radiation Measurement, Unknown
Report No.(s): DE98-052868; SAND-98-8558C; CONF-980369; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Water vapor plays an important role in the energetics of the boundary layer processes which in turn play a key role in regulating regional and global climate. It plays a primary role in Earth's hydrological cycle, in radiation balance as a direct absorber of infrared radiation, and in atmospheric circulation as a latent heat energy source as well as in determining cloud development and atmospheric stability. Water vapor concentration, expressed as a mass mixing ratio, is conserved in all meteorological processes except condensation and evaporation. This property makes it an ideal choice for studying many of the atmosphere's dynamic features. Raman scattering measurements from lidar also allow retrieval of water vapor mixing ratio profiles at high temporal and vertical resolution. Raman lidars sense water vapor to altitudes not achievable with towers and surface systems, sample the atmosphere at much higher temporal resolution than radiosondes or satellites, and do not require strong vertical gradients or turbulent fluctuations in temperature that is required by acoustic sounders and radars. Analysis of highly resolved water vapor profiles are used here to characterize two important mesoscale flows: thunderstorm outflows and a cold front passage.
NTIS
Water Vapor; Troposphere; Raman Spectra; Climate Change; Meteorology; Atmospheric Moisture; Climatology; Mesoscale Phenomena; Atmospheric Sounding

19990032509 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
What does a tensiometer measure in fractured rock?
Finsterle, S., Department of Energy, USA; Faybishenko, B., Department of Energy, USA; Feb. 28, 1998; 14p; In English
Report No.(s): DE98-052894; LBNL-41454; CONF-9710205; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Tensiometers are routinely used in both the laboratory and the field for measuring the capillary pressure in unsaturated porous media. The authors conducted a laboratory experiment on a fractured basalt core. They also examined the performance of a tensiometer in fractured porous media by means of numerical simulation, in which the tensiometer itself and its interaction with the formation were explicitly modeled. They conclude that the gauge pressure is primarily affected by the fracture rock component fracture or matrix that conducts water into or out of the ceramic cup of the tensiometer. Fracture flow is accurately monitored during imbibition events, whereas during drainage, the matrix capillary pressure is registered, leading to a strong hysteretic behavior in the pressure measurements.
NTIS
Tensiometers; Fracturing; Pressure Measurement; Porous Materials; Multiphase Flow

19990032582 NASA Goddard Space Flight Center, Greenbelt, MD USA

Development of a Model for the Night Side Magnetopause using Global Simulations ***Final Report, 1 May 1997 - 31 Dec. 1998***

Raeder, Joachim, NASA Goddard Space Flight Center, USA; 1998; 4p; In English

Contract(s)/Grant(s): NAG5-4684; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

During the final year of this investigation we have finished several event studies that we considered necessary for the development of a tail magnetopause model and for the calibration of our simulation code. We have not reached the ultimate goal of the project, i.e., the development of an analytical tail magnetopause model. In the course of the investigation we have learned that such a model would be much more complex than we had anticipated. However, the investigations that we conducted towards this goal have led to significant results and discoveries that are of considerable value for understanding the tail magnetopause. These are summarized in the following sections.

Author

Magnetopause; Computerized Simulation; Models

19990032594 Harvard Univ., Div. of Engineering and Applied Sciences, Cambridge, MA USA

Stratospheric Tracers of Atmospheric Transport (STRAT) Campaign: ER-2 Participation ***Final Report, 1 Mar. 1995 - 30 Sep. 1998***

Anderson, James G., Harvard Univ., USA; Mar. 23, 1995; 7p; In English

Contract(s)/Grant(s): NCC-2-913; NCC2-892; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The NASA Stratospheric Tracers of Atmospheric Transport (STRAT) mission was initiated to advance knowledge of the major transport mechanisms of the upper troposphere-lower stratosphere. This is the region of the atmosphere within which exchange processes take place that critically determine the response of the climate system and ozone distribution to changing conditions triggered by the release of chemicals at the surface. The mission series that extended from October 1995 to November 1997 was extremely successful. The scientific advances that emerged from that mission include analyses of: (1)troposphere-to-stratosphere transport in the lowermost stratosphere from measurements of H2O, CO2, N2O, and O3; (2) the effects of tropical cirrus clouds on the abundance of lower stratospheric ozone; and (3) the role of HO(x) in super- and subsonic aircraft exhaust plumes; and dehydration and denitrification in the arctic polar vortex during the 1995-96 winter.

Derived from text

Atmospheric Circulation; Stratosphere; Nitrogen Oxides; Troposphere; Exhaust Gases; Arctic Regions

47
METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

19990028349 NASA Goddard Space Flight Center, Greenbelt, MD USA

Boreal Winter Predictions with the GEOS-2 GCM: The Role of Boundary Forcing and Initial Conditions

Chang, Yehui, NASA Goddard Space Flight Center, USA; Schubert, Siegfried D., NASA Goddard Space Flight Center, USA; Suarez, Max J., NASA Goddard Space Flight Center, USA; Dec. 21, 1998; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Ensembles of atmospheric General Circulation Model (GCM) seasonal forecasts and long-term simulations (1980-94) are analyzed to assess the controlling influences of boundary forcing and memory of the initial conditions. Both the forecasts and simulations are carried out with version 2 of the Goddard Earth Observing System (GEOS-2) GCM forced with observed sea surface temperatures (SSTs). While much of the focus is on the seasonal time scale (January- March) and the Pacific North American (PNA) region, we also present results for other regions, shorter time scales, and other known modes of variability in the northern hemisphere extratropics. Forecasts of indices of some of the key large-scale modes of variability show that there is considerable variability in skill between different regions of the Northern Hemisphere. The eastern North Atlantic region has the poorest long lead forecast skill showing no skill beyond about 10 days. Skillful seasonal forecasts are primarily confined to the wave-like ENSO response emanating from the tropical Pacific. In the Northern Hemisphere, this is associated with the well-known Pacific/North American (PNA) pattern. Memory of the initial conditions is the major factor leading to skillful extratropical forecasts of lead time less than one month, while SST forcing is the only factor at the seasonal time scale. SST forcing contributes to skillful forecasts at sub- seasonal time scales only over the PNA region. The GEOS-2 GCM produces average (1980-94) signal to noise ratios which are less than one everywhere in the extratropics, except for the subtropical Pacific where they approach 1.5. When confined to the ENSO years, the maximum signal to noise ratios occur in the PNA region where they exceed three. An assessment of the

sampling distribution of the forecasts suggests the model's ENSO response is very likely too weak. These results show some sensitivity to the uncertainties in the estimates of the SST forcing fields. In the North Pacific region, the sensitivity to SST forcing manifests itself primarily as changes in the variability of the PNA response, underscoring the need for an ensemble approach to the seasonal prediction problem.
Author
GEOS 2 Satellite; Boundary Conditions; Atmospheric General Circulation Models; Forecasting

19990028481 Department of Energy, Office of Energy Research, Washington, DC USA
Daytime Raman lidar measurements of water vapor during the ARM 1997 water vapor intensive observation period
Turner, D. D., Department of Energy, USA; Goldsmith, J. E. M., Department of Energy, USA; Apr. 30, 1998; 5p; In English; 19th; Laser Radar, USA
Report No.(s): DE98-052864; SAND-98-8563C; CONF-980722; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Because of the importance of water vapor, the ARM program initiated a series of three intensive operating periods (IOPs) at its CART (Cloud And Radiation Testbed) site. The goal of these IOPs is to improve and validate the state-of-the-art capabilities in measuring water vapor. to date, two of the planned three IOPs have occurred: the first was in September of 1996, with an emphasis on the lowest kilometer, while the second was conducted from September- -October 1997 with a focus on both the upper troposphere and lowest kilometer. These IOPs provided an excellent opportunity to compare measurements from other systems with those made by the CART Raman lidar. This paper addresses primarily the daytime water vapor measurements made by the lidar system during the second of these IOPs.
NTIS
Optical Radar; Water Vapor; Daytime; Radar Measurement

19990028514 NASA Goddard Space Flight Center, Greenbelt, MD USA
FIRE Arctic Clouds Experiment
Curry, J. A., Colorado Univ., USA; Hobbs, P. V., Washington Univ., USA; King, M. D., NASA Goddard Space Flight Center, USA; Randall, D. A., Colorado State Univ., USA; Minnis, P., NASA Langley Research Center, USA; Issac, G. A., Atmospheric Environment Service, Canada; Pinto, J. O., Colorado Univ., USA; Uttal, T., National Oceanic and Atmospheric Administration, USA; Bucholtz, A., Scripps Institution of Oceanography, USA; Cripe, D. G., Colorado State Univ., USA; Gerber, H., Gerber Scientific, Inc., USA; Fairall, C. W., National Oceanic and Atmospheric Administration, USA; Garrett, T. J., Washington Univ., USA; Hudson, J., Desert Research Inst., USA; Intrieri, J. M., National Oceanic and Atmospheric Administration, USA; Jakob, C., SPEC, Inc., USA; Jensen, T., NASA Ames Research Center, USA; Lawson, P., NASA Ames Research Center, USA; Marcotte, D., Atmospheric Environment Service, Canada; Nguyen, L., NASA Langley Research Center, USA; Bulletin American Meteorological Society; 1998; 54p; In English; Original contains color illustrations; Sponsored in part by the Canadian Panel on Energy Research and Development; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An overview is given of the First ISCCP Regional Experiment (FIRE) Arctic Clouds Experiment that was conducted in the Arctic during April through July, 1998. The principal goal of the field experiment was to gather the data needed to examine the impact of arctic clouds on the radiation exchange between the surface, atmosphere, and space, and to study how the surface influences the evolution of boundary layer clouds. The observations will be used to evaluate and improve climate model parameterizations of cloud and radiation processes, satellite remote sensing of cloud and surface characteristics, and understanding of cloud-radiation feedbacks in the Arctic. The experiment utilized four research aircraft that flew over surface-based observational sites in the Arctic Ocean and Barrow, Alaska. In this paper we describe the programmatic and science objectives of the project, the experimental design (including research platforms and instrumentation), conditions that were encountered during the field experiment, and some highlights of preliminary observations, modelling, and satellite remote sensing studies.
Author
Alaska; Arctic Regions; Boundary Layers; Climate Models; Clouds (Meteorology); Experiment Design; Radiative Transfer; Air Water Interactions

19990028794 Department of Energy, Office of Energy Research, Washington, DC USA
Quantifying hydrometeor advection and the vertical distribution of cloud fraction over the SGP CART Site
Miller, M., Department of Energy, USA; Verlinde, J., Department of Energy, USA; May 31, 1998; 6p; In English; 8th; Atmospheric radiation measurement, USA
Report No.(s): DE98-005773; BNL-65556; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A single column model (SCM) is, in essence, an isolated grid column of a general circulation model (GCM). Hence, SCMs have rather demanding input data requirements, but do not suffer from problems associated with balance of a GCM. Among the initial conditions that must be used to describe the initial state of the SCM column are the vertical profile of the horizontal wind components and the vertical profiles of cloud water and ice. In addition, the large scale divergence and advective tendencies of cloud water and ice must be supplied as external parameters. Finally, the liquid and ice cloud amount as a function of height within the SCM column are required for model evaluation.
NTIS
Hydrometeors; Vertical Distribution; Atmospheric General Circulation Models; Fractions; Advection

19990028795 Department of Energy, Office of Energy Research, Washington, DC USA
Comparison of millimeter-wave cloud radar measurements for the Fall 1997 Cloud IOP
Sekelsky, S. M., Department of Energy, USA; Li, L., Department of Energy, USA; Galloway, J., Department of Energy, USA; McIntosh, R. E., Department of Energy, USA; Miller, M. A., Department of Energy, USA; May 31, 1998; 6p; In English; 8th; Atmospheric radiation measurement, USA
Report No.(s): DE98-005772; BNL-65555; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
One of the primary objectives of the Fall 1997 IOP was to intercompare Ka-band (350 Hz) and W-band (95 GHz) cloud radar observations and verify system calibrations. During September 1997, several cloud radars were deployed at the Southern Great Plains (SOP) Cloud and Radiation Testbed (CART) site, including the full time operation 35 GHz CART Millimeter-wave Cloud Radar (MMCR), the University of Massachusetts (UMass) single antenna 33 GHz/95 GHz Cloud Profiling Radar System (CPRS), the 95 GHz Wyoming Cloud Radar (WCR) flown on the University of Wyoming King Air, the University of Utah 95 GHz radar and the dual-antenna Pennsylvania State University 94 GHz radar. In this paper the authors discuss several issues relevant to comparison of ground-based radars, including the detection and filtering of insect returns. Preliminary comparisons of ground-based Ka-band radar reflectivity data and comparisons with airborne radar reflectivity measurements are also presented.
NTIS
Millimeter Waves; Clouds (Meteorology); Radar Tracking

19990031961 Minnesota Univ., Dept. of Electrical and Computer Engineering, Duluth, MN USA
Automatic Visibility Measurement System Based on Video Cameras ***Final Report, 1996 - 1998***
Kwon, T. M., Minnesota Univ., USA; September 1998; 78p; In English
Contract(s)/Grant(s): Proj. 74708
Report No.(s): PB99--123473; MN/RC-1998-25; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The Minnesota Department of Transportation (Mn/DOT) conducted a two-year study on visibility measurement methods using video cameras. This report describes the study's theoretical basis, practical methods, and experimental results.
NTIS
Visibility; Algorithms; Numerical Analysis; Density Measurement; Video Equipment

19990031965 California Univ., San Diego, Scripps Institution of Oceanography, La Jolla, CA USA
Absorption of Solar Radiation by the Cloudy Atmosphere Interpretations of Collocated Aircraft Measurements
Valero, Francisco P. J., California Univ., San Diego, USA; Cess, Robert D., State Univ. of New York, USA; Zhang, Minghua, State Univ. of New York, USA; Pope, Shelly K., California Univ., San Diego, USA; Bucholtz, Anthony, California Univ., San Diego, USA; Bush, Brett, California Univ., San Diego, USA; Vitko, John, Jr., Sandia National Labs., USA; Journal of Geophysical Research; Dec. 27, 1997; ISSN 0148-0227; Volume 102, No. D25, pp. 29,917-29,927; In English
Contract(s)/Grant(s): DE-FG03-95ER-69183; DE-FG02-85ER-60314; DE-FG02-90ER-61063; NAG5-3135
Report No.(s): Paper-97JD01782; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
As part of the Atmospheric Radiation Measurement (ARM) Enhanced Shortwave Experiment (ARESE), we have obtained and analyzed measurements made from collocated aircraft of the absorption of solar radiation within the atmospheric column between the two aircraft. The measurements were taken during October 1995 at the ARM site in Oklahoma. Relative to a theoretical radiative transfer model, we find no evidence for excess solar absorption in the clear atmosphere and significant evidence for its existence in the cloudy atmosphere. This excess cloud solar absorption appears to occur in both visible (0.224-0.68 microns) and near-infrared (0.68-3.30 microns) spectral regions, although not at 0.5 microns for the visible contribution, and it is shown to be true absorption rather than an artifact of sampling errors caused by measuring three-dimensional clouds.
Author
Solar Radiation; Atmospheric Radiation; Radiation Absorption; Radiation Measurement; Radiative Transfer

19990032068 NASA Goddard Space Flight Center, Greenbelt, MD USA

Precipitation-Based ENSO Indices

Adler, Robert, NASA Goddard Space Flight Center, USA; Curtis, Scott, Maryland Univ. Baltimore County, USA; Journal of Climate; 1998; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this study gridded observed precipitation data sets are used to construct rainfall-based ENSO indices. The monthly El Nino and La Nina Indices (EI and LI) measure the steepest zonal gradient of precipitation anomalies between the equatorial Pacific and the Maritime Continent. This is accomplished by spatially averaging precipitation anomalies using a spatial boxcar filter, finding the maximum and minimum averages within a Pacific and Maritime Continent domain for each month, and taking differences. EI and LI can be examined separately or combined to produce one ENSO Precipitation Index (ESPI). ESPI is well correlated with traditional sea surface temperature and pressure indices, leading Nino 3.4. One advantage precipitation indices have over more conventional indices, is describing the strength and position of the Walker circulation. Examples are given of tracking the impact of ENSO events on the tropical precipitation fields.

Author

El Nino; Rain; Precipitation; Gradients

19990032082 Army Cold Regions Research and Engineering Lab., Hanover, NH USA

Bibliography on Cold Regions Science and Technology, Volume 52

Goldblatt, R. W., Editor; Minkus, C., Editor; Radford, O. K., Editor; Dec. 1998; 368p; In English

Report No.(s): AD-A359399; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The Bibliography on Cold Regions Science and Technology was first published in 1951 and is a continuing publication of the Cold Regions Bibliography Project (CRBP) in the Federal Research Division of the Library of Congress. It is sponsored by and prepared for the Cold Regions Research and Engineering Laboratory (formerly Snow, Ice and Permafrost Research Establishment) of the U.S. Army Corps of Engineers. Volumes 1-15 were issued as the Bibliography on Snow, Ice, and Permafrost, SIPRE Report 12. Beginning with volume 16 the designation was changed to CRREL Report 12. With Volume 20 the title was changed to Bibliography on Snow, Ice and Frozen Ground, with Abstracts, and with volume 23 the current title was adopted. The present volume contains material accessioned between October 1997 and September 1998. It contains full citations of 6734 items, in many cases with abstracts. Indexing for the volume is issued as Volume 52, Part 2. This publication is the result of a coordinated effort. The bibliography work was done by the CRBP Staff who entered all data on a single computerized database that accommodates both the Bibliography on Cold Regions Science and Technology and the Antarctic Bibliography thus eliminating duplication of effort between the two bibliographies. Citations were entered in the Cuadra STAR system, and camera-ready copy for printing was produced using the FrameMaker composition system. This publication is available from the National Technical Information Service, Springfield, Virginia 22151. When ordering, the author and subject indexes (Part 2) should also be requested, as the usefulness of the bibliography would be severely limited without them.

DTIC

Polar Regions; Bibliographies; Low Temperature Environments; Indexes (Documentation)

19990032083 Army Cold Regions Research and Engineering Lab., Hanover, NH USA

Bibliography on Cold Regions Science and Technology, Volume 52

Goldblatt, R. W., Editor; Minkus, C., Editor; Radford, O. K., Editor; Dec. 1998; 651p; In English

Report No.(s): AD-A359400; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The Bibliography on Cold Regions Science and Technology was first published in 1951 and is a continuing publication of the Cold Regions Bibliography Project (CRBP) in the Federal Research Division of the Library of Congress. It is sponsored by and prepared for the Cold Regions Research and Engineering Laboratory (formerly Snow, Ice and Permafrost Research Establishment) of the U.S. Army Corps of Engineers. Volumes 1-15 were issued as the Bibliography on Snow, Ice, and Permafrost, SIPRE Report 12. Beginning with volume 16 the designation was changed to CRREL Report 12. With Volume 20 the title was changed to Bibliography on Snow, Ice and Frozen Ground, with Abstracts, and with volume 23 the current title was adopted. This companion issue to Volume 52, Part 1, contains author and subject headings for the volume. In the author index, principal and joint personal and corporate authors are listed along with the title, date, pagination, and language of the document and the accession number. The subject index is composed of four basic elements: 1) terms taken from a controlled vocabulary based on the Thesaurus of Engineering and Scientific Terms (LEX-EJC) 2) free terms added as needed 3) geographic names, generally entered under countries 4) cross references suggesting additional appropriate terms. The terms are listed in a single alphabetical arrangement, along with title (original, translated, abridged, expanded, or supplied), principal author, date, pagination, and language of pertinent docu-

ments, and their accession numbers. This publication is available from the National Technical Information Service, Springfield, Virginia 22151. When ordering, both Parts 1 and 2 should be requested, as they are complementary.
DTIC
Polar Regions; Bibliographies; Indexes (Documentation)

19990032289 NASA Ames Research Center, Moffett Field, CA USA
Recent Research Results on Extraterrestrial Lightning
Borucki, W. J., NASA Ames Research Center, USA; 1984; 5p; In English; 7th; Atmospheric Electricity, 3-8 Jun. 1984, Albany, NY, USA; Sponsored by American Meteorological Society, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The whistler rate estimated from the plasma wave analyser implies a lightning flash Evidence exists for lightning activity on the Earth, Jupiter, Saturn, and Venus. analysis of spacecraft observations gives a better idea of how the activity varies from planet to planet, but leave many questions unanswered. This paper will examine recent research results on extraterrestrial compare the characteristics of terrestrial and extraterrestrial lightning, and examine the questions raised by the comparisons. Excellent reviews of terrestrial lightning are available in Lightning (Uman, 1969), Lightning (edited by Golde, 1977), and Handbook of Atmospherics (edited by Vollard, 1982). Review articles on extraterrestrial lightning have been presented b'y Rinnert (1982), Levin et al (1983), and Williams et al (1983). Because of the availability of these review articles, only a brief review will be included here where needed. This paper is organized into sections discussing lightning activity on Jupiter, Venus, and Saturn. Next a brief section is presented on the level of lightning activity that can be expected on Titan. A short section comparing the characteristics of terrestrial and extraterrestrial lightning is followed by a section discussing questions raised by the observations. The last section summarizes results.
Derived from text
Lightning; Earth (Planet); Venus (Planet); Jupiter (Planet); Atmospherics; Satellite Observation; Extraterrestrial Environments

19990032361 Environmental Protection Agency, National Exposure Research Lab., Research Triangle Park, NC USA
Modeling Stomatal Response to Atmospheric Humidity
Pleim, J. E., Environmental Protection Agency, USA; 1999; 8p; In English
Report No.(s): PB99-126526; EPA/600/A-98/129; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Our primary interest is to find the most realistic, robust, practical, and economical way to represent the effects of humidity on stomatal conductance in a mesoscale meteorology and air quality model system. In particular, the authors have developed a land surface model, coupled to the Penn State/NCAR Mesoscale Meteorology model (MM5) and the Community Multiscale Air Quality (CMAQ) model to simulate both evapotranspiration and chemical dry deposition. This paper describes a series of modeling experiments where several parameterizations of stomatal response to humidity are studied. The test code is simply extracted from the 3-D grid model so that the results are directly applicable to the mesoscale modeling system.
NTIS
Atmospheric Moisture; Humidity; Air Quality; Atmospheric Models

19990032570 NASA Goddard Space Flight Center, Greenbelt, MD USA
Raman Lidar Measurements of Aerosol Extinction and Backscattering, Report 1, Methods and Comparisons
Ferrare, R. A., Hughes STX, Inc., USA; Melfi, S. H., Maryland Univ. Baltimore County, USA; Whiteman, D. N., NASA Goddard Space Flight Center, USA; Evans, K. D., Maryland Univ. Baltimore County, USA; Leifer, R., Department of Energy, USA; Journal of Geophysical Research; Aug. 27, 1998; ISSN 0148-0227; Volume 103, D16, pp. 19,663-19,672; In English
Report No.(s): Paper-98JD01646; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper examines the aerosol backscattering and extinction profiles measured at night by the NASA Goddard Space Flight Center Scanning Raman Lidar (SRL) during the remote cloud sensing (RCS) intensive operations period (IOP) at the Department of Energy Atmospheric Radiation Measurement (ARM) southern Great Plains (SGP) site in April 1994. These lidar data are used to derive aerosol profiles for altitudes between 0.0 1 5 and 5 km. Since this lidar detects Raman scattering from nitrogen and oxygen molecules as well as the elastic scattering from molecules and aerosols, it measures both aerosol backscattering and extinction simultaneously. The aerosol extinction/backscattering ratio varied between approximately 30 sr and 75 sr at 351 nm. Aerosol optical thicknesses derived by integrating the lidar profiles of aerosol extinction measured at night between 0. I and 5 km are found to be about 10-40% lower than those measured by a Sun photometer during the day. This difference is attributed to the contribution by stratospheric aerosols not included in the lidar estimates as well as to diurnal differences in aerosol properties and concentrations. Aerosol profiles close to the surface were acquired by pointing the lidar nearly horizontally. Measurements of aerosol scattering from a tower-mounted nephelometer are found to be 40% lower than lidar measurements of aerosol extinction over a wide

range of relative humidities even after accounting for the difference in wavelengths. The reasons for this difference are not clear but may be due to the inability of the nephelometer to accurately measure scattering by large particles.
Author
Aerosols; Atmospheric Radiation; Backscattering; Great Plains Corridor (North America); Remote Sensing; Extinction

19990032571 NASA Goddard Space Flight Center, Greenbelt, MD USA
Raman Lidar Measurements of Aerosol Extinction and Backscattering, Report 2, Derivation of Aerosol Real Refractive Index, Single-Scattering Albedo, and Humidification Factor using Raman Lidar and Aircraft Size Distribution Measurements
Ferrare, R. A., Hughes STX, Inc., USA; Melfi, S. H., Maryland Univ. Baltimore County, USA; Whiteman, D. N., NASA Goddard Space Flight Center, USA; Evans, K. D., Maryland Univ. Baltimore County, USA; Poellot, M., North Dakota Univ., USA; Kaufman, Y. J., NASA Goddard Space Flight Center, USA; Journal of Geophysical Research; Aug. 27, 1998; ISSN 0148-0227; Volume 103, No. D16, pp. 19,673-19,689; In English; Original contains color illustrations
Contract(s)/Grant(s): DOE-83221
Report No.(s): Paper-98JD01647; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Aerosol backscattering and extinction profiles measured by the NASA Goddard Space Flight Center Scanning Raman Lidar (SRL) during the remote cloud sensing (RCS) intensive operations period (IOP) at the Department of Energy Atmospheric Radiation Measurement (ARM) southern Great Plains (SGP) site during two nights in April 1994 are discussed. These profiles are shown to be consistent with the simultaneous aerosol size distribution measurements made by a PCASP (Passive Cavity Aerosol Spectrometer Probe) optical particle counter flown on the University of North Dakota Citation aircraft. We describe a technique which uses both lidar and PCASP measurements to derive the dependence of particle size on relative humidity, the aerosol real refractive index n, and estimate the effective single-scattering albedo Omega(sub 0). Values of n ranged between 1.4-1.5 (dry) and 1.37-1.47 (wet); Omega(sub 0) varied between 0.7 and 1.0. The single-scattering albedo derived from this technique is sensitive to the manner in which absorbing particles are represented in the aerosol mixture; representing the absorbing particles as an internal mixture rather than the external mixture assumed here results in generally higher values of Omega(sub 0). The lidar measurements indicate that the change in particle size with relative humidity as measured by the PCASP can be represented in the form discussed by Hattel with the exponent gamma = 0.3 + or - 0.05. The variations in aerosol optical and physical characteristics captured in the lidar and aircraft size distribution measurements are discussed in the context of the meteorological conditions observed during the experiment.
Author
Aerosols; Albedo; Atmospheric Radiation; Backscattering; Great Plains Corridor (North America); Radiation Measurement; Weather; Atmospheric Effects; Atmospheric Chemistry; Solar Radiation; Extinction; Particle Size Distribution

19990032581 State Univ. of New York, Marine Sciences Research Center, Stony Brook, NY USA
Absorption of Solar Radiation by the Cloudy Atmosphere: Further Interpretations of Collocated Aircraft Measurements
Cess, R. D., State Univ. of New York, USA; Zhang, Minghua, State Univ. of New York, USA; Valero, Francisco P. J., Scripps Institution of Oceanography, USA; Pope, Shelly K., Scripps Institution of Oceanography, USA; Bucholtz, Anthony, Scripps Institution of Oceanography, USA; Bush, Brett, Scripps Institution of Oceanography, USA; Zender, Charles S., National Center for Atmospheric Research, USA; Journal of Geographical Research; 1998; In English
Contract(s)/Grant(s): NAS1-1264; DE-FG02-85ER-6013; DE-FG02-90ER-61063; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We have extended the interpretations made in two prior studies of the aircraft shortwave radiation measurements that were obtained as part of the Atmospheric Radiation Measurements (ARM) Enhanced Shortwave Experiments (ARESE). These extended interpretations use the 500 nm (10 nm bandwidth) measurements to minimize sampling errors in the broadband measurements. It is indicated that the clouds present during this experiment absorb more shortwave radiation than predicted by clear skies and thus by theoretical models, that at least some (less than or equal to 20%) of this enhanced cloud absorption occurs at wavelengths less than 680 nm, and that the observed cloud absorption does not appear to be an artifact of sampling errors nor of instrument calibration errors.
Author
Solar Radiation; Atmospheric Radiation; Instrument Errors; Radiation Absorption; Mathematical Models

48
OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

19990028503 Environmental Protection Agency, Chesapeake Bay Program, Annapolis, MD USA
Chesapeake Bay Watershed Model Application and Calculation of Nutrient and Sediment Loadings, Appendix F, Point Source Loadings
Wiedeman, A., Environmental Protection Agency, USA; Cosgrove, A., Chesapeake Research Consortium, Inc., USA; 1998; 706p; In English
Report No.(s): PB99-115511; CBP/TRS-207/98; EPA/903/R-98/014; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Appendix F documents in detail the Phase IV Chesapeake Bay Watershed Model point source nutrient data assimilation process for the facilities located in signatory and non-signatory jurisdictions of the Chesapeake Bay Watershed. This document includes a description of the data sources, the methods of assimilation, types of analysis performed to determine nutrient reduction estimates, and trends in nutrient loadings discharged to the Chesapeake Bay Watershed. The Phase IV Watershed Model Point Source Database includes information for approximately 612 (the exact number varying depending on the year) active industrial, municipal, and federal facilities discharging directly to surface waters within the Chesapeake Bay watershed from all signatory and non-jurisdictions including: New York, Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia. Facility information, and flow and loading data are included for each of the 612 facilities for the years 1985 through 1996, 2000, Tributary Strategy Implementation (which is expected to occur after the year 2000) and additional nutrient reduction scenarios. The following flow and loading parameters are included: flow, total nitrogen, nitrate, organic nitrogen, total phosphorus, phosphate, organic phosphorous, biochemical oxygen demand, and dissolved oxygen.
NTIS
Chesapeake Bay (US); Sediments; Nutrients; Water Pollution; Surface Water; Point Sources

19990028536 National Academy of Sciences - National Research Council, Ocean Studies Board, Washington, DC USA
From Monsoons to Microbes: Understanding the Ocean's Role in Human Health
1999; In English
Contract(s)/Grant(s): NAG5-7512; Copyright; Avail: Issuing Activity (National Academy Press, Washington, DC), Hardcopy, Microfiche

The United Nations has declared 1998 the International Year of the Ocean. Activities during this year have provided a renewed appreciation for the resources obtained from the ocean, the effects of human activities on the health of the ocean, and the importance of the ocean in regulating the world's climate. The more we learn about ocean processes and ocean life, the more we realize how critical the ocean will be for the future well-being of humankind. Human health is one of the areas strongly influenced by the ocean. There are negative impacts such as the spread of infectious diseases, coastal weather hazards, and harmful algal blooms, and positive impacts such as the use of marine organisms to develop new medical treatments and a better understanding of biological processes. In recognition of the International Year of the Ocean, the National Research Council held a workshop on the Ocean's Role in Human Health in June, 1998. The workshop brought together members of the ocean sciences and biomedical communities to identify areas where improved understanding of marine processes and systems has the potential to reduce public health risks and enhance our existing biomedical capabilities. This document serves as an overview, based partly on discussions at the workshop, of the impacts of the ocean on human health with emphasis on (1) elucidating connections between the ocean and human health, (2) evaluating the present state of knowledge about these connections, and (3) suggesting how current and future efforts may be directed so that we can anticipate and respond to future health needs and threats.
Author
Infectious Diseases; Marine Biology; Marine Meteorology; Microorganisms; Oceanography; Oceans; Public Health; Weather; Pharmacology; Cells (Biology); Axons; Estuaries; Marine Environments; Marine Resources

19990028623 NASA Goddard Space Flight Center, Greenbelt, MD USA
SIMBIOS Project 1998 Annual Report
McClain, Charles R., NASA Goddard Space Flight Center, USA; Fargion, Giulietta, S., General Sciences Corp., USA; March 1999; 118p; In English
Report No.(s): NASA/TM-1999-208645; Rept-99E00818; NAS 1.15:208645; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The purpose of this series of technical reports is to provide current documentation of the Sensor Intercomparison and Merger for Biological and Interdisciplinary Ocean Studies (SIMBIOS) Project activities, NASA Research Announcement (NRA) research status, satellite data processing, data product validation and field calibration. This documentation is necessary to ensure that critical information is related to the scientific community and NASA management. This critical information includes the technical difficulties and challenges of combining ocean color data from an array of independent satellite systems to form consistent and accurate global bio-optical time series products. This technical report is not meant to substitute for scientific literature. Instead, it will provide a ready and responsive vehicle for the multitude of technical reports issues by an operational project.
Author
NASA Programs; Sea-Viewing Wide Field-Of-View Sensor; Documentation; Data Processing; Project Management

19990028663 Texas A&M Univ., Trace Element Research Lab., College Station, TX USA
National Status and Trends Program for Marine Environmental Quality: Historical Contamination of Mississippi River Delta, Tampa Bay, and Galveston Bay Sediments ***Final Report***
Presley, B. J., Texas A&M Univ., USA; Wade, T. L., Texas A&M Univ., USA; Santschi, P., Texas A&M Univ., USA; Baskaran, M., Texas A&M Univ., USA; Mar. 1998; 156p; In English
Report No.(s): PB99-119315; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

In order to obtain sediment which has accumulated over the past 100 years or so, 50-80 cm long sediment cores were collected from the submarine Mississippi River Delta, Galveston Bay, Texas and Tampa Bay, Florida. The cores were extruded and sliced into 1 cm thick sections which were then radiometrically age dated and analyzed for those organic compounds and trace metals suspected of being contaminants in the sampling areas.
NTIS
Water Pollution; Chemical Analysis; Sampling; Marine Environments; Mississippi River (US); Organic Compounds; Contamination

19990031861 NASA Goddard Space Flight Center, Greenbelt, MD USA
SeaWiFS Postlaunch Technical Report Series, Volume 3, The SeaBOARR-98 Field Campaign
Zibordi, Giuseppe, Joint Research Centre of the European Communities, Italy; Lazin, Gordana, Dalhousie Univ., Canada; McLean, Scott, Satlantic, Inc., Canada; Firestone, Elaine R., Editor, General Sciences Corp., USA; Hooker, Stanford B., Editor, NASA Goddard Space Flight Center, USA; March 1999; ISSN 1522-8789; 45p; In English
Contract(s)/Grant(s): ENV4-CT96-0307; MAS3-CT97-0087
Report No.(s): NASA/TM-1999-206892/VOL3; NAS 1.15:206892/VOL3; Rept-99B00021; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents the scientific activities during the first Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Bio-Optical Algorithm Round-Robin (SeaBOARR-98) experiment, which took place from 5-17 July 1998, at the Acqua Alta Oceanographic Tower (AAOT) in the northern Adriatic Sea off the coast of Italy. The ultimate objective of the SeaBOARR activity is to evaluate the effect of different measurement protocols on bio-optical algorithms using data from a variety of field campaigns. The SeaBOARR-98 field campaign was concerned with collecting a high quality data set of simultaneous in-water and above-water radiometric measurements. The deployment goals documented in this report were to: a) use four different surface glint correction methods to compute water-leaving radiances, L W (lambda), from above-water data; b) use two different in-water profiling systems and three different methods to compute L W (lambda) from in-water data (one making measurements at a fixed distance from the tower, 7.5 m, and the other at variable distances up to 29 m away); c) use instruments with a common calibration history to minimize intercalibration uncertainties; d) monitor the calibration drift of the instruments in the field with a second generation SeaWiFS Quality Monitor (SQM-II), to separate differences in methods from changes in instrument performance; and e) compare the L W (lambda) values estimated from the above-water and in-water measurements. In addition to describing the instruments deployed and the data collected, a preliminary analysis of the data is presented, and the kind of follow-on work that is needed to completely assess the estimation of L W (lambda) from above-water and in-water measurements is discussed.
Author
Algorithms; Calibrating; Correction; Data Acquisition; Estimating; Field of View; Experimentation

19990031950 NASA Goddard Space Flight Center, Greenbelt, MD USA

SeaWiFS Postlaunch Technical Report Series, Volume 3, The SeaBOARR-98 Field Campaign

Hooker, Stanford B., Editor, NASA Goddard Space Flight Center, USA; Firestone, Elaine R., Editor, General Sciences Corp., USA; Zibordi, Giuseppe, Joint Research Centre of the European Communities, Italy; Lazin, Gordana, Dalhousie Univ., Canada; McLean, Scott, Satlantic, Inc., Canada; March 1999; 44p; In English

Report No.(s): NASA/TM-1999-206892/VOL3; NAS 1.15:206892/VOL3; Rept-99B00021; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents the scientific activities during the first Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Bio- Optical Algorithm Round-Robin (SeaBOARR-98) experiment, which took place from 5-17 July 1998, at the Acqua Alta Oceanographic Tower (AAOT) in the northern Adriatic Sea off the coast of Italy. The ultimate objective of the SeaBOARR activity is to evaluate the effect of different measurement protocols on bio-optical algorithms using data from a variety of field campaigns. The SeaBOARR-98 field campaign was concerned with collecting a high quality data set of simultaneous in-water and above-water radiometric measurements. The deployment goals documented in this report were to: a) use four different surface glint correction methods to compute water-leaving radiances, L(sub W)(Lambda), from above-water data; b) use two different in-water profiling systems and three different methods to compute L(sub W)(Lambda) from in-water data (one making measurements at a fixed distance from the tower, 7.5 m, and the other at variable distances up to 29 m away); c) use instruments with a common calibration history to minimize intercalibration uncertainties; d) monitor the calibration drift of the instruments in the field with a second generation SeaWiFS Quality Monitor (SQM-IT), to separate differences in methods from changes in instrument performance; and e) compare the L(sub W)(Lambda) values estimated from the above-water and in-water measurements. In addition to describing the instruments deployed and the data collected, a preliminary analysis of the data is presented, and the kind of follow-on work that is needed to completely assess the estimation of L(sub W)(Lambda) from above-water and in-water measurements is discussed.

Author

Algorithms; Radiometers; Data Acquisition; Ocean Data Acquisitions Systems; Oceanography; Field of View

19990032219 National Research Council of Canada, Inst. for Environmental Research and Technology, Ottawa, Ontario Canada

NOAA National Status and Trends Program Twelfth Round Intercomparison Exercise Results for Trace Metals in Marine Sediments and Biological Tissues: National Status and Trends Program for Marine Environmental Quality

Willie, S., National Research Council of Canada, Canada; Nov. 1998; 128p; In English

Report No.(s): PB99-123069; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The report summarizes the results of the Twelfth Round Intercomparison for Trace Metals in Marine Sediments and Biological Tissues under the directive of the NOAA National Status and Trends Program. A total of forty-four participants were included in the exercise, including NOAA, USEPA, state, Austrailian, Canadian, Mexican and Argentinean laboratories. Two samples were sent by NRC to each participant, a marine sediment collected on the east coast of Canada and a freeze-dried mussel tissue. Laboratories were also asked to analyse two certified reference materials (CRMs) MESS-2 and CRM 2976. The elements to be determined were Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg, and Pb for both matrices, plus Be, Si, Mn, Sb, and Tl for the sediments. An accepted mean and confidence interval was calculated for each analyte in the two unknown samples, laboratory biases were identified and an overall rating of superior, good, fair or others were assigned to each laboratory.

NTIS

Marine Environments; Sediments; Tissues (Biology); Trace Elements; Metals; Water Pollution; Environment Effects

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

19990028360 Toigo Associates, Inc., Woodbridge, VA USA

Health Technology Assessment Tool: Telemedicine, Phase 1, Re-Engineering Laboratory *Final Report*

Jul. 15, 1998; 343p; In English

Contract(s)/Grant(s): DAAB07-93-D-A263

Report No.(s): AD-A360194; CAAS-98-002; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

The goal of this study is to design a prototype assessment tool for evaluating technologies relevant to Telemedicine. The assessment tool will be used to guide future investments and review and analyze current AMEDD projects in Telemedicine.
DTIC
Telemedicine; Medical Equipment

19990028377 Department of Energy, Office of Energy Research, Washington, DC USA
MCNP speed advances for boron neutron capture therapy
Goorley, J. T., Department of Energy, USA; McKinney, G., Department of Energy, USA; Adams, K., Department of Energy, USA; Estes, G., Department of Energy, USA; Apr. 30, 1998; 5p; In English; Radiation protection and shielding: technologies for the new century, USA
Report No.(s): DE98-004377; LA-UR-97-5135; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Boron Neutron Capture Therapy (BNCT) treatment planning process of the Beth Israel Deaconess Medical Center-M.I.T team relies on MCNP to determine dose rates in the subject's head for various beam orientations. In this time consuming computational process, four or five potential beams are investigated. Of these, one or two final beams are selected and thoroughly evaluated. Recent advances greatly decreased the time needed to do these MCNP calculations. Two modifications to the new MCNP4B source code, lattice tally and tracking enhancements, reduced the wall-clock run times of a typical one million source neutrons run to one hour twenty five minutes on a 200 MHz Pentium Pro computer running Linux and using the GNU FORTRAN compiler. Previously these jobs used a special version of MCNP4AB created by Everett Redmond, which completed in two hours two minutes. In addition to this 30% speedup, the MCNP4B version was adapted for use with Parallel Virtual Machine (PVM) on personal computers running the Linux operating system. MCNP, using PVM, can be run on multiple computers simultaneously, offering a factor of speedup roughly the same as the number of computers used. With two 200 MHz Pentium Pro machines, the run time was reduced to forty five minutes, a 1.9 factor of improvement over the single Linux computer. While the time of a single run was greatly reduced, the advantages associated with PVM derive from using computational power not already used. Four possible beams, currently requiring four separate runs, could be run faster when each is individually run on a single machine under Windows NT, rather than using Linux and PVM to run one after another with each multiprocessed across four computers. It would be advantageous, however, to use PVM to distribute the final two beam orientations over four computers.
NTIS
Boron; Neutrons; Therapy; Capture Effect; Beams (Radiation)

19990028498 Texas Univ. Health Science Center, Houston, TX USA
Applications of Anabolic Vitamin D Analogs as Countermeasures to Bone Loss ***Final Report***
Karin, Norman J., Texas Univ. Health Science Center, USA; Jun. 30, 1998; 3p; In English
Contract(s)/Grant(s): NCC9-36; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The experiments in Round 2 were designed to extend the results of our efforts in Round 1 which led us to hypothesize that the seco-steroid, 1,25-dihydroxyvitamin D3[1,25(OH)2D3], acts in synergy with parathyroid hormone (PTH) to regulate bone calcium homeostasis. Our work centered on one particular target of 1,25(OH)2D3 action, the voltage-sensitive calcium channels (VSCC's), which are activated acutely by this steroid within milliseconds of exposure . A second area of research focused on the effects of mechanical strain on VSCC expression in bone. These experiments were performed in collaboration with Dr. Steven Goldstein (Univ. Michigan), who generously provided RNA extracted from dog bones that had been exposed to mechanical strain in vivo. Our results suggest that mechanical loading elevated VSCC expression in the long bones from 3 of the 6 animals tested. A second line of experimentation, carried out in collaboration with Dr. Randall Duncan, a NASA-funded investigator in Indianapolis, centered on RT-PCR analysis of effects of mechanical strain on Ca2(+) channel expression in cultured bone cells. Compared to unstrained controls, the expression of vitamin-D-sensidve Ca2(+) channels is elevated 3- to 5-fold over a 24 hr period.
Derived from text
Bones; Countermeasures; Calcium; Calciferol; Calcium Metabolism; Biological Effects; Aerospace Medicine

19990028500 National Science and Technology Council, Committee on Environment and Natural Resources, Washington, DC USA
Endocrine Disruptors: Research Needs and Priorities, 1998
Dec. 1998; 50p; In English
Report No.(s): PB99-119257; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The document provides an analysis of the Inventory of Federally funded research on endocrine disrupting chemicals prepared by the Working Group. Federal agencies are currently funding several hundred research projects relating to endocrine disruption, and there is also a considerable amount of basic research funded by the Federal government on the biochemistry of hormones and

their regulation and control of physiological processes. The Inventory indicates that the largest efforts are in human health research, which is clearly dominant over ecological and exposure research. Reproductive and developmental toxicity endpoints are receiving considerable attention in both human and ecological research, while carcinogenicity and neurotoxicity studies are well represented in human health, but not in ecological research. Few studies are underway in the area of immunotoxicity. On-going research also addresses only a limited number of organisms and agents. The non-human species most studied are laboratory mammals, with fish the most prevalent group in studies focused on species from the natural environment. PCBs, dioxins, and persistent pesticides are the most commonly studied chemical classes, with little attention being given to other chemicals, such as alkylphenols, phthalate esters, or nonpersistent pesticides.
NTIS
Endocrinology; Research Projects; Contaminants; Endocrine Systems

19990028602 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Developing the Sandia National Laboratories transportation infrastructure for isotope products and wastes
Trennel, A. J., Department of Energy, USA; Nov. 30, 1997; 10p; In English; 12th; PATRAM '98: Packaging and Transportation of Radioactive Material, USA
Report No.(s): DE98-001386; SAND-97-0776C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The US Department of Energy (DOE) plans to establish a medical isotope project that would ensure a reliable domestic supply of molybdenum-99 ((sup 99) Mo) and related medical isotopes (Iodine-125, Iodine-131, and Xenon-133). The Department's plan for production will modify the Annular Core Research Reactor (ACRR) and associated hot cell facility at Sandia National Laboratories (SNL) /New Mexico and the Chemistry and Metallurgy Research facility at Los Alamos National Laboratory (LANL). Transportation activities associated with such production is discussed.
NTIS
Standardization; Wastes; Radioactive Isotopes

19990031871 Institute of Space Medico-Engineering, Beijing, China
Space Medicine and Medical Engineering, Volume 11 ***Hangtian Yixue yu Yixue Gongcheng***
Wei, Jin-He, Editor, Institute of Space Medico-Engineering, China; Aug. 1998; ISSN 1002-0837; 86p; In English; In Chinese
Report No.(s): PB99-127805; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche

This journal issue includes articles discussing the following subjects: 1) Linear and nonlinear analysis of heart rate variability during lower body negative pressure; 2) Simulation study on +Gz protection afforded by extended coverage anti-G suits; 3) Mutation induced by space conditions in Escherichia coli strains; 4) Biological effect of space flight on edible fungi onboard recoverable scientific satellite; 5) Study on mechanisms of T Lymphocyte function changes in mice under simulated weightlessness in terms of IL-2 and Bel-2 Gene transcription; 6) Effects of simulated weightlessness and irradiation on metabolism of rat myocardial cells cultured in vitro; 7) Five year follow-up of contrast vision of normal eyes; 8) Study on temporal character of visual function and working efficiency; 9) Effect of noise on human mental rotation performance; 10) Changes in cerebral circulation function during head-down bed rest for 7 days; 11) Effects of task load level and input modiality format on P(sub 3) wave of event related brain potential; 12) Changes of T-SOD activity and MDA, GSH contents in blood of guinea pigs after exposure to narrow-band noise; and 13) Study on application of neural networks to hierarchical optimal control of large scale systems. Also included are brief reports on bone cykotines and compensating regulation in rats, physiological changes after parachuting in humans, and effects of tail suspension on mitochondrial Ca(+2), Mg(+2) and parameters of electron microscopic morphometry in rats skeletal muscle. Finally, a special article on Noninvasive evaluation of cardiovascular autonomic regulation and its application in physiological studies under weightlessness, a literature review and special news is presented.
CASI
Aerospace Medicine; Medical Science; Physiological Effects; Weightlessness; Gravitational Effects

19990031938 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
A Methodology for Measuring the Physiological Strain of Enhanced Soldiers: The 1998 Soldier Combat System Enhancement Study
Amos, Denys; Cotter, James D.; Lai, Aai-Man; Forbes-Ewan, Christopher H.; Nov. 1998; 101p; In English
Report No.(s): AD-A360624; DSTO-TR-0747; DODA-AR-010-678; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The prime objective of the 1998 Soldier Combat System Enhancement Study was to assess, develop and verify methods to evaluate the physiological performance of dismounted soldiers with basic or enhanced capabilities conducting routine operations in the tropics. Core temperature, mean skin temperature and heart rate are appropriate measures for evaluating the physiological

burden of soldier combat system enhancements. Current techniques for measuring mean skin temperature and heart rates are adequate. The measurement of core temperature using rectal thermistors has significant limitations, especially during vigorous activities. Studies of the hydration status of soldiers can be conducted using relatively straightforward methods to determine water intake, weight loss, urine production, and total sweat rate by weight differences. For field studies of hydration, there may be no need to analyze urine for sodium; specific gravity is more easily measured and appears to provide adequate information on hydration status. The robustness of the Metamax used for VO2 measurements was demonstrated and provided real time measurements of oxygen consumption, and of metabolic stress associated with activities.
DTIC
Physiological Effects; Procedures; Body Temperature; Human Body; Skin Temperature (Biology); Temperature Measurement

19990032085 Norwegian Defence Research Establishment, Kjeller, Norway
Evaluation of Health Effects in Connection with a Change in Fuel Type from Diesel to F-34 ***Vurdering av Helsemessige Konsekvenser ved Overgang Fra Autodiesel Til Forsvarets Flydrivstoff (F-34)***
Arnt, Johnsen, Norwegian Defence Research Establishment, Norway; Tornes, John Aa, Norwegian Defence Research Establishment, Norway; Nov. 18, 1998; 64p; In Norwegian
Contract(s)/Grant(s): Proj. FFITOX/Oppdr-297001/138.
Report No.(s): FFI/RAPPORT-98/05899; ISBN 82-464-0309-5; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The consequences to human health and to the ecosystem connected with the substitution of diesel with F-34 jet fuel on ground vehicles have been evaluated. There are no indications that such a change will cause any enhanced health hazard or environmental hazard.
Author
Jet Engine Fuels; Health; Hazards

19990032206 NASA Langley Research Center, Hampton, VA USA
Aerospace Medicine and Biology: A Continuing Bibliography with Indexes, Supplement 489
Apr. 19, 1999; 56p; In English
Report No.(s): NASA/SP-1999-7011/SUPPL489; NAS 1.21:7011/SUPPL489; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This supplemental issue of Aerospace Medicine and Biology, A Continuing Bibliography with Indexes (NASA/SP-1999-7011) lists reports, articles, and other documents recently announced in the NASA STI Database. In its subject coverage, Aerospace Medicine and Biology concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.
CASI
Aerospace Medicine; Bibliographies; Exobiology; Indexes (Documentation)

19990032593 Baylor Coll. of Medicine, Houston, TX USA
Artificial Gravity as a Countermeasure of Cardiovascular Deconditioning in Spinal Cord Injury ***Final Report***
Cardus, David, Baylor Coll. of Medicine, USA; February 1999; 14p; In English
Contract(s)/Grant(s): NCC9-36; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
An essential item in the development of this project was the availability of the artificial gravity simulator (AGS). At the termination of that grant in 1994, the AGS was dismantled and transferred to NASA Johnson Space Center. It took over two years for the AGS to be re-assembled and re-certified for use. As a consequence of the non-availability of the AGS for two years, there was a considerable delay in implementing the various phases of the project. The subjects involved in the study were eight healthy able bodied subjects and twelve with spinal cord injury. After analysis of the data collected on these subjects, six of the healthy able bodied subjects and three of the sub ects with spinal cord injury were found to qualify for the study. This report gives the results of four subjects only, two healthy able bodied and two spinal cord injured subjects because the period of the grant (1 year) and its extension (1 year) expired before additional subjects could be studied. The principal objective of the study was to conduct a

series of experiments to demonstrate the feasibility of utilizing artificial gravity to assist in the physical rehabilitation of persons with spinal cord injuries.
Author
Artificial Gravity; Injuries; Spinal Cord; Cardiovascular System; Hemodynamic Responses; Physiological Responses

53
BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

19990032553 Department of Energy, Washington, DC USA
Different understanding: science through the eyes of visual thinkers
Sesko, S. C., Department of Energy, USA; Marchant, M., Department of Energy, USA; Sep. 11, 1997; 27p; In English, USA; Meeting sponsored in part by American Inst. for Graphic Arts
Report No.(s): DE98-052267; UCRL-JC-128489; CONF-9711118; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this emergent study was to follow the cognitive and creative processes demonstrated by five art student participants as they integrated a developing knowledge of big science, as practiced at the Department of Energy's Lawrence Livermore National Laboratory, into a personal and idiosyncratic visual, graphical, or multimedia product. The non-scientist participants involved in this process attended design classes sponsored by the Laboratory at the Art Center College of Design in California. The learning experience itself, and how the students arrived at their product, were the focus of the class and the research. We believe that this study contributes to the literature on science education, art education, cognitive change, and public understanding of science.
NTIS
Education; Cognition; Human Behavior; Creativity

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.

19990028369 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
In-vehicle human factors for integrated multi-function systems: Making ITS user-friendly
Spelt, P. F., Department of Energy, USA; Scott, S., Department of Energy, USA; Apr. 30, 1998; 13p; In English; Sponsored by Interactive Telemedical Systems, USA
Report No.(s): DE98-005664; ORNL/CP-98317; CONF-980563; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As more and more Intelligent Transportation System in-vehicle equipment enters the general consumer market, the authors are about to find out how different design engineers are from ordinary drivers. Driver information systems are being developed and installed in vehicles at an ever-increasing rate. These systems provide information on diverse topics of concern and convenience to the driver, such as routing and navigation, emergency and collision warnings, and a variety of motorists services, or yellow pages functions. Most of these systems are being developed and installed in isolation from each other, with separate means of gathering the information and of displaying it to the driver. The current lack of coordination among on-board systems threatens to create a situation in which different messages on separate displays will be competing with each other for the drivers attention. Urgent messages may go unnoticed, and the number of messages may distract the driver from the most critical task of controlling the vehicle. Thus, without good human factors design and engineering for integrating multiple systems in the vehicle, consumers may find ITS systems confusing and frustrating to use. The current state of the art in human factors research and design for in-vehicle systems has a number of fundamental gaps. Some of these gaps were identified during the Intelligent Vehicle Initiative Human Factors Technology Workshop, sponsored by the US Department of Transportation, in Troy, Michigan, December 10--11, 1997. One task for workshop participants was to identify needed research areas or topics relating to in-vehicle human factors. The top ten unmet research needs from this workshop are presented. Many of these gaps in human factors research knowledge indicate the need for standardization in the functioning of interfaces for safety-related devices such as collision avoidance systems (CAS) and adaptive cruise controls (ACC). Such standards and guidelines will serve to make the safety-critical aspects of these systems

consistent across different manufacturers, thereby reducing the likelihood of driver surprise. A second area to emerge from the Workshop concerns research into techniques for integrating multiple devices in vehicles.
NTIS
Human Factors Engineering; Transportation; Collision Avoidance; Adaptive Control

19990028443 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
The Resistance to Thermal and Moisture Transmission and Durability of Candidate Rainwear Fabrics
Egglestone, G. T.; Oct. 1998; 21p; In English
Report No.(s): AD-A360601; DSTO-TR-0733; DODA-AR-010-656; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The current in-service raincoat used by the Army is considered unsuitable for operations in northern Australia due to its lack of 'breathability'. Breathability in a raincoat is directly related to the ability of the fabric to transport heat and moisture vapor at a rate that will keep the body in a state of thermal equilibrium under operational conditions. Five candidate fabrics were tested for their durability and resistance to the transport of heat and moisture vapor. The waterproof component of two of the fabrics was a coating while the other three were waterproofed using semi-permeable membranes. From a comfort viewpoint the worst fabric was that currently used in the in-service raincoat.
DTIC
Protective Clothing; Synthetic Fibers; Waterproofing; Heat Transfer; Moisture Resistance

19990032524 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Task 8.6--Advanced Man Machine Interface (MMI)
Dec. 31, 1997; 13p; In English
Report No.(s): DE98-002021; DOE/MC/30246-5813; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Solar/DOE ATS engine program seeks to improve the utilization of turbomachinery resources through the development of an Advanced Man Machine Interface (MMI). The program goals include timely and succinct feedback to the operations personnel to enhance their decision making process. As part of the Solar ATS Phase 2 technology development program, enabling technologies, including graphics environments, communications technology, and operating systems were explored to determine their viability to support the overall MMI requirements. This report discusses the research and prototyping effort, as well as the conclusions reached.
NTIS
Human-Computer Interface; Gas Turbines; ATS; Research and Development; Gas Turbine Engines

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MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

19990028605 Department of Energy, Washington, DC USA
Uncertainty and error in computational simulations
Oberkampf, W. L., Department of Energy, USA; Diegert, K. V., Department of Energy, USA; Alvin, K. F., Department of Energy, USA; Rutherford, B. M., Department of Energy, USA; Oct. 31, 1997; 24p; In English; Thermophysics and Heat Transfer, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-000927; SAND-97-2607C; CONF-980610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The present paper addresses the question: 'What are the general classes of uncertainty and error sources in complex, computational simulations.' This is the first step of a two step process to develop a general methodology for quantitatively estimating the global modeling and simulation uncertainty in computational modeling and simulation. The authors develop a comprehensive view of the general phases of modeling and simulation. The phases proposed are: conceptual modeling of the physical system, mathematical modeling of the system, discretization of the mathematical model, computer programming of the discrete model, numerical solution of the model, and interpretation of the results. This new view is built upon combining phases recognized in the disciplines of operations research and numerical solution methods for partial differential equations. The characteristics and activities of each of these phases are discussed in general, but examples are given for the fields of computational fluid dynamics and heat transfer. They argue that a clear distinction should be made between uncertainty and error that can arise in each of these phases. The present definitions for uncertainty and error are inadequate and. therefore, they propose comprehensive definitions

for these terms. Specific classes of uncertainty and error sources are then defined that can occur in each phase of modeling and simulation. The numerical sources of error considered apply regardless of whether the discretization procedure is based on finite elements, finite volumes, or finite differences. to better explain the broad types of sources of uncertainty and error, and the utility of their categorization, they discuss a coupled-physics example simulation.
NTIS
Errors; Computerized Simulation; Procedures; Models; Estimating; Computer Programming

19990028606 Department of Energy, Washington, DC USA
Modular redundant number systems
May 31, 1998; 11p; In English; EUROCRYPT '98, USA
Report No.(s): DE98-000847; SAND-97-2732C; CONF-980536; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

With the increased use of public key cryptography, faster modular multiplication has become an important cryptographic issue. There are two parts to modular multiplication: multiplication and modular reduction. Though there are fast methods for multiplying and fast methods for doing modular reduction, they do not mix well. to date, it has been better to use the fast modular reduction technique coupled with standard multiplication. Standard modular reduction is much more costly than standard multiplication. Fast modular reduction (Montgomery's method) reduces the reduction cost to approximately that of a standard multiply. of the fast multiplication techniques, the Redundant Number System (RNS) technique is one of the most popular. It is simple, converting a large convolution (multiply) into many smaller independent ones. RNS form implies working modulo another constant. Depending on the relationship between these two constants; reduction OR division may be possible, but not both. This paper describes a new technique using ideas from both Montgomery's method and RNS. It avoids the formula problem and allows fast reduction and multiplication. Since RNS form is used throughout, it also allows the entire process to be parallelized.
NTIS
Data Transmission; Cryptography; Security

19990032362 Royal Inst. of Tech., Dept. of Mathematics, Stockholm, Sweden
Remarks on the Parameter-Dependence of Natural Measures for Quadratic Maps
Thunberg, H., Royal Inst. of Tech., Sweden; Jan. 1998; ISSN 1401-2278; 18p; In English
Report No.(s): PB98-170889; TRITA-MAT-98-MA-06; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Almost all maps f(a) in the quadratic family possesses a unique natural measure, that is, an invariant probability measure mu(a) describing the asymptotic distribution of almost all orbits. We discuss weak-(dis)continuity properties of the map a approaches mu(a). For a large set A of maps with an absolutely continuous natural measure, arbitrarily small perturbations can create several different types of dynamics. This is much in the spirit of unfolding homoclinic bifurcations. We show that almost all maps in A have the property that mu(a) can be approximated with measures supported on periodic attractors of certain nearby maps. Given a is a member of A, we also exhibit open sets of parameters corresponding to periodic attractors, accumulating on a, such that their natural measures approximate singular (non-natural) invariant measure of f(a). It follows that a approaches mu(a) is not weak continuous on any full-measure subset of (0,2].
NTIS
Quadratic Equations; Independent Variables

19990032568 Ohio State Univ., Dept. of Civil and Environmental Engineering and Geodetic Science, Columbus, OH USA
Ocean Domains and Maximum Degree of Spherical Harmonic and Orthonormal Expansions
Rapp, R., Ohio State Univ., USA; January 1999; 40p; In English
Contract(s)/Grant(s): NAS5-32352
Report No.(s): NASA/CR-1999-208628; NAS 1.26:208628; Rept-99B00012; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ocean domains used for the orthonormal (ON) systems are studied to determine the maximum degree of spherical harmonic and orthonormal expansions that can be constructed. Although it was shown that one domain was restricted to degree 24, others were shown could be constructed to determine expansions to at least degree 36. Since 1991 the maximum degree expansion used for several Ohio State studies has been 24. In this report it is shown that the maximum degree for the ocean domain used by Wang and Rapp [1994] was 32 and 29 for the domain used by Rapp, Zhang, Yi [1996]. A modification of the former domain was developed (D1e) that enabled a solution to degree 36 to be determined. A modification of the Rapp, Zhang, Yi domain (D7d) enabled a degree 30 solution to be made. Combination coefficients were developed for domain D1e, to degree 36, and to degree 30 for domain D7d. The degree 30 spherical harmonic expansion provided by Pavlis [1998] of the POCM_4B dynamic ocean topogra-

phy (DOT), and the degree 30 part of the degree 360 expansion [Rapp. 1998] of the POCM_4B model was converted to an ON expansion valid for the D7d domain. The degree 36 part of the degree 360 expansion was converted to the ON expansion for the D1e domain. The square root of the degree variances of the various solutions were compared. The root mean square value of DOT from the Pai,lis expansion, after conversion to the ON system, was + or - 66.52 cm (D7d domain). The value from the degree 30 part of the 360 expansion was + or - 66.65 cm. The value based on the actual POCM-4B data, in the D7d domain, was + or - 66.74 cm showing excellent agreement with the ON results. If the spherical harmonic coefficients had been used the implied root mean square value was + or - 60.76 cm [Pavlis] and + or -59.70 cm [Rapp].
Author
Oceans; Topography; Orthonormal Functions; Wavelet Analysis; Dynamical Systems; Spherical Harmonics; Geodesy

19990032591 Naval Postgraduate School, Monterey, CA USA
Summary of Research 1997, Department of Mathematics, *1 Jan. 1997 - 31 Dec. 1997*
Woods, W. M.; Neta, Beny; Jan. 1999; 42p; In English
Report No.(s): AD-A360489; NPS-09-98-014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report contains summaries of research projects in the Department of Mathematics. A list of recent publications is also included which consists of conference presentations and publications, books, contributions to books, published journal papers, technical reports, and thesis abstracts.
DTIC
Documents; Mathematics

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COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing. For components see 33 Electronics and Electrical Engineering.

19990028350 NASA Goddard Space Flight Center, Greenbelt, MD USA
Technology Assessment of High Capacity Data Storage Systems: Can We Avoid a Data Survivability Crisis
Halem, M., NASA Goddard Space Flight Center, USA; Shaffer, F., NASA Goddard Space Flight Center, USA; Palm, N., NASA Goddard Space Flight Center, USA; Salmon, E., NASA Goddard Space Flight Center, USA; Raghavan, S., Raytheon STX Corp., USA; Kempster, L., Raytheon STX Corp., USA; 1998; In English; 10th; RCI's North American Member Executive Conference, 13-15 Oct. 1998, Washington, DC, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The density of digital storage media in our information-intensive society increases by a factor of four every three years, while the rate at which this data can be migrated to viable long-term storage has been increasing by a factor of only four every nine years. Meanwhile, older data stored on increasingly obsolete media, are at considerable risk. When the systems for which the media were designed are no longer serviced by their manufacturers (many of whom are out of business), the data will no longer be accessible. In some cases, older media suffer from a physical breakdown of components - tapes simply lose their magnetic properties after a long time in storage. The scale of the crisis is compatible to that facing the Social Security System. Greater financial and intellectual resources to the development and refinement of new storage media and migration technologies in order to preserve as much data as possible.
Author
Data Storage; Magnetic Properties; Risk; Commerce

19990031940 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Software Architecture and Design: Proceedings of the Joint International Computers Limited/University of Newcastle Seminar Held at the University of Newcastle, *7-11 Sep. 1998*
Shaw, M., Newcastle-upon-Tyne Univ., UK; Clements, P., Newcastle-upon-Tyne Univ., UK; 1998; 288p; In English
Report No.(s): PB99--122673; Copyright Waived; Avail: CASI; A13, Hardcopy; A03, Microfiche

Contents: Instrumented Connectors; A COTS Infrastructure for Domain Specific Diagram Semantics; The Design of Design: Evolution of a Software Engineering Laboratory Course; Artist-Designers and Engineer-Designers: What You Get is What You See; Problem Analysis and Structure; Dynamic Object Model; Design and Documentation of Program Structures; Generic Architecture Descriptions for Product Lines; A Product Line Architecture for a Network Product; Constructing Systems from Parts: What Students Should Learn about Software Architecture; Architectural Mismatch, Interoperability, and the Prospects for Elec-

tronic Commerce in Software Parts and Services; and A Field Guide to Boxology: Preliminary classification of Architectural Styles for Software Systems.
NTIS
Software Engineering; Design Analysis; Architecture (Computers); Conferences

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COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

19990028367 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Year 2000 compliance concerns with the ISA Thermoluminescent Dosimetry Data Processing (TL-DP) software system
Saviz, K., Department of Energy, USA; May 26, 1998; 42p; In English; 17th; Panasonic TLD, USA
Report No.(s): DE98-005674; RFP-5188; CONF-980661; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The year 2000 is rapidly approaching, and there is a good chance that computer systems that utilize two digit year dates will experience problems in retrieval of date information. The ISA Thermoluminescent Dosimetry Data Processing (TL-DP) software and computer system has been reviewed for Year 2000 compliance issues.
NTIS
Data Processing; Computer Systems Programs; Thermoluminescence; Dosimeters

19990028522 Department of Energy, Office of Energy Research, Washington, DC USA
Lilith: A software framework for the rapid development of scalable tools for distributed computing
Gentile, A. C., Department of Energy, USA; Evensky, D. A., Department of Energy, USA; Armstrong, R. C., Department of Energy, USA; Mar. 31, 1998; 18p; In English; 7th; High Performance Distributed Computing, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-052511; SAND-98-8514C; CONF-980719; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Lilith is a general purpose framework, written in Java, that provides a highly scalable distribution of user code across a heterogeneous computing platform. by creation of suitable user code, the Lilith framework can be used for tool development. The scalable performance provided by Lilith is crucial to the development of effective tools for large distributed systems. Furthermore, since Lilith handles the details of code distribution and communication, the user code need focus primarily on the tool functionality, thus, greatly decreasing the time required for tool development. In this paper, the authors concentrate on the use of the Lilith framework to develop scalable tools. The authors review the functionality of Lilith and introduce a typical tool capitalizing on the features of the framework. They present new Objects directly involved with tool creation. They explain details of development and illustrate with an example. They present timing results demonstrating scalability.
NTIS
Programming Languages; Data Processing; Computer Programs

19990028612 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Parallelization of an Object-Oriented Unstructured Aeroacoustics Solver
Baggag, Abdelkader, Purdue Univ., USA; Atkins, Harold, NASA Langley Research Center, USA; Oezturan, Can, Bogazici Univ., Turkey; Keyes, David, Institute for Computer Applications in Science and Engineering, USA; February 1999; 16p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209098; ICASE-99-11; NAS 1.26:209098; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A computational aeroacoustics code based on the discontinuous Galerkin method is ported to several parallel platforms using MPI. The discontinuous Galerkin method is a compact high-order method that retains its accuracy and robustness on non-smooth unstructured meshes. In its semi-discrete form, the discontinuous Galerkin method can be combined with explicit time marching methods making it well suited to time accurate computations. The compact nature of the discontinuous Galerkin method also makes it well suited for distributed memory parallel platforms. The original serial code was written using an object-oriented approach and was previously optimized for cache-based machines. The port to parallel platforms was achieved simply by treating partition boundaries as a type of boundary condition. Code modifications were minimal because boundary conditions were

abstractions in the original program. Scalability results are presented for the SCI Origin, IBM SP2, and clusters of SGI and Sun workstations. Slightly superlinear speedup is achieved on a fixed-size problem on the Origin, due to cache effects.
Author
Aeroacoustics; Unstructured Grids (Mathematics); Galerkin Method; Object-Oriented Programming; Parallel Programming; Applications Programs (Computers)

19990028618 NASA Wallops Flight Center, Wallops Island, VA USA
ICESat (GLAS) Science Processing Software Document Series, Volume 1, Science Software Management Plan, 3.0
Hancock, David W., III, NASA Wallops Flight Center, USA; February 1999; 125p; In English
Contract(s)/Grant(s): RTOP 229-15-77-38
Report No.(s): NASA/TM-1999-208641/VER3/VOL1; Rept-99B00020/VER3/VOL1; NAS 1.15:208641/VER3/VOL1; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This document provides the Software Management Plan for the GLAS Standard Data Software (SDS) supporting the GLAS instrument of the EOS ICESat Spacecraft. The SDS encompasses the ICESat Science Investigator-led Processing System (I-SIPS) Software and the Instrument Support Terminal (IST) Software. For the I-SIPS Software, the SDS will produce Level 0, Level 1, and Level 2 data products as well as the associated product quality assessments and descriptive information. For the IST Software, the SDS will accommodate the GLAS instrument support areas of engineering status, command, performance assessment, and instrument health status.
Author
Earth Observing System (EOS); Information Systems; Information Management; Management Systems; Software Engineering; Data Processing

19990028639 Department of Energy, Washington, DC USA
BR eigenvalue algorithm
Geist, G. A., Department of Energy, USA; Howell, G. W., Department of Energy, USA; Watkins, D. S., Department of Energy, USA; Nov. 30, 1997; 19p; In English; Applied Linear Algebra, USA
Report No.(s): DE98-004819; ORNL/CP-97328; CONF-9711130; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The BR algorithm, a new method for calculating the eigenvalues of an upper Hessenberg matrix, is introduced. It is a bulge-chasing algorithm like the QR algorithm, but, unlike the QR algorithm, it is well adapted to computing the eigenvalues of the narrowband, nearly tridiagonal matrices generated by the look-ahead Lanczos process. This paper describes the BR algorithm and gives numerical evidence that it works well in conjunction with the Lanczos process. On the biggest problems run so far, the BR algorithm beats the QR algorithm by a factor of 30--60 in computing time and a factor of over 100 in matrix storage space.
NTIS
Algorithms; Eigenvalues; Procedures; Computation

19990028817 Science Applications International Corp., Albuquerque, NM USA
The Applicability of ADS to Precision Guided Munitions Testing
McKee, Larry; Sep. 1998; 10p; In English; Presented at the Simulation Interoperability Workshop Sep 98, Orlando, FL.
Report No.(s): AD-A359365; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Systems Integration Test (SIT) was executed by the Joint Advanced Distributed Simulation (JADS) Joint Test Force (JTF) and evaluated the utility of using ADS to support cost-effective testing of an integrated missile weapon/launch aircraft system in an operationally realistic scenario. The SIT scenarios simulated a single shooter aircraft launching an air-to-air missile against a single target aircraft. Extensive testing was performed involving two different ADS architectures: (1) the shooter and target were represented by manned flight laboratories and the missile by an AIM-9M Sidewinder hardware-in-the-loop (HWIL) laboratory; and (2) the shooter and target were represented by live F-16 fighters and the missile by an AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM) HWIL laboratory. Testing was completed in October 1997, and evaluation of the results supports the conclusion that each ADS configuration has utility for T&E of the corresponding air-to-air missile involved. The applicability of ADS for the T&E of precision guided munitions (PGM) in general was assessed by extending the results and lessons learned from the SIT testing. The PGM classes considered were air-to-air missiles (AAMs), surface-to-air missiles (SAMs), air-to-ground munitions (AGM), surface-to-surface munitions, and subsurface munitions. In the ADS applications considered, the PGM could be represented by either a digital simulation model (DSM) or by an HWIL and the shooter and target could be represented by either live platforms, HWIL laboratories, or DSMs. The choice of shooter, target, and PGM representation depends on the test objectives, the details of the scenario, and the performance area and type of PGM being evaluated. This paper describes

the various PGM T&E applications for which the JADS JTF believes ADS has utility. Limitations in applying ADS to PGM T&E are identified, along with applications for which ADS is judged to have little or no utility.
DTIC
Computerized Simulation; Missile Systems; Digital Simulation; Systems Integration; Weapon Systems; Hardware-In-The-Loop Simulation

19990028832 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Proof in the Analysis of a Model of a Tracking System
Fitzgerald, J. S., Newcastle-upon-Tyne Univ., UK; Jones, C. B., Manchester Univ., UK; Jul. 1998; 36p; In English
Report No.(s): PB99--122541; TRS-617; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fully formal proof is not always possible within the financial and labour constraints of a commercial project. This report shows how knowledge of the structure of a proof can guide inspections and reviews, even when the proof itself is not to be derived. The study illustrates, on a reduced example, the main issues which arose as part of the proof-based analysis of a specification of a tracking mechanisms for a nuclear plant.
NTIS
Tracking (Position); Systems Analysis; Inspection

19990031839 Department of Energy, Washington, DC USA
Numerical model representation and validation strategies
Dolin, R. M., Department of Energy, USA; Hefele, J., Department of Energy, USA; Oct. 31, 1997; 10p; In English; Computers, Graphics and Visualization, USA
Report No.(s): DE98-004106; LA-UR-97-4081; CONF-980531; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes model representation and validation strategies for use in numerical tools that define models in terms of topology, geometry, or topography. Examples of such tools include Computer-Assisted Engineering (CAE), Computer-Assisted Manufacturing (CAM), Finite Element Analysis (FEA), and Virtual Environment Simulation (VES) tools. These tools represent either physical objects or conceptual ideas using numerical models for the purpose of posing a question, performing a task, or generating information. Dependence on these numerical representations require that models be precise, consistent across different applications, and verifiable. This paper describes a strategy for ensuring precise, consistent, and verifiable numerical model representations in a topographic framework. The main assertion put forth is that topographic model descriptions are more appropriate for numerical applications than topological or geometrical descriptions. A topographic model verification and validation methodology is presented.
NTIS
Mathematical Models; Proving

19990031843 Department of Energy, Office of Energy Research, Washington, DC USA
Lilith: A Java Framework for the Development of Scalable Tools for High Performance Distributed Computing Platforms
Evensky, D. A., Department of Energy, USA; Gentile, A. C., Department of Energy, USA; Armstrong, R. C., Department of Energy, USA; Mar. 19, 1998; 21p; In English; Java for High Performance Network Computers, 1998, USA; Sponsored by Association for Computing Machinery, USA
Report No.(s): DE98-052521; SAND-98-8448C; CONF-980223; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Increasingly, high performance computing constitutes the use of very large heterogeneous clusters of machines. The use and maintenance of such clusters are subject to complexities of communication between the machines in a time efficient and secure manner. Lilith is a general purpose tool that provides a highly scalable, secure, and easy distribution of user code across a heterogeneous computing platform. by handling the details of code distribution and communication, such a framework allows for the rapid development of tools for the use and management of large distributed systems. Lilith is written in Java, taking advantage of Java's unique features of loading and distributing code dynamically, its platform independence, its thread support, and its provision of graphical components to facilitate easy to use resultant tools. The authors describe the use of Lilith in a tool developed for the maintenance of the large distributed cluster at their institution and present details of the Lilith architecture and user API (Automatic Programming Instruction) for the general user development of scalable tools.
NTIS
Java (Programming Language); Computer Information Security; Computer Networks

19990031845 Department of Energy, Washington, DC USA

PRE: A Framework for Enterprise Integration

Whiteside, R. A., Department of Energy, USA; Friedman-Hill, E. J., Department of Energy, USA; Detry, R. J., Department of Energy, USA; Mar. 31, 1998; 16p; In English; Distributed Information Infrastructure Systems for Manufacturing, USA

Report No.(s): DE98-052524; SAND-98-8505C; CONF-980540; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sandia National Laboratories' Product Realization Environment (PRE) is a lightweight, CORBA based framework for the integration of a broad variety of applications. These applications are wrapped for use in the PRE framework as reusable components. For example, some of the PRE components currently available include: (1) product data management (PDM) system, (2) human resources database, several finite element analysis programs, and (3) a variety of image and document format converters. PRE enables the development of end user applications (as Java applets, for example) that use these components as building blocks. To aid such development, the PreLib library (available in both C++ and Java) permits both wrapping and using these components without knowledge of either CORBA or the security mechanisms used.

NTIS

Applications Programs (Computers); Software Engineering; Architecture (Computers); Computer Systems Design; Computer Programming

19990031853 Rutherford Appleton Lab., Mathematical Software Group, Chilton, UK

Development of the EVEREST Device Modeling Software for Charge Generation Events

Fowler, R. F., Rutherford Appleton Lab., UK; Ashby, J. V., Rutherford Appleton Lab., UK; Greenough, C., Rutherford Appleton Lab., UK; Nov. 11, 1998; ISSN 1358-6254; 26p; In English

Report No.(s): PB99-120552; RAL-TR-1998-075; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The modelling of CCD and pixel detector devices is an important area in which semiconductor device modelling can be applied to better understand and optimize new designs. The three dimensional device modelling suite EVEREST has been extended to deal with charge generation events which occur when a charged particle or X-ray strikes a semiconductor detector. This report details the developments that have been made to model these events and presents some initial results to validate the changes to the software.

NTIS

Semiconductor Devices; Charge Coupled Devices; Computerized Simulation

19990031887 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Important considerations in experimental design for large scale simulation analyses

Rutherford, B., Department of Energy, USA; May 31, 1998; 11p; In English; Systems engineering and software, USA; Sponsored by Lockheed Martin Corp., USA

Report No.(s): DE98-005537; SAND-98-0313C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Economic and other factors accompanying developments in physics, mathematics and particularly in computer technology are shifting a substantial portion of the experimental resources associated with large scale engineering projects from physical testing to modeling and simulation. In the process, the priorities of selecting meaningful and informative tests and simulations to perform are also changing. This paper describes issues related to experimental design and how the goals and priorities of the experimental design for these problems are changing to accommodate the this shift in experimentation. Issues, priorities and new methods of approach are discussed.

NTIS

Computer Systems Design; Experiment Design

19990031897 Department of Energy, Washington, DC USA

Dynamic isosurface extraction and level-of-detail in voxel space

Linebarger, J. M., Department of Energy, USA; Lamphere, P. B., Department of Energy, USA; Breckenridge, A. R., Department of Energy, USA; Jun. 30, 1998; 17p; In English

Report No.(s): DE98-005688; SAND-98-1224; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new visualization technique is reported, which dramatically improves interactivity for scientific visualizations by working directly with voxel data and by employing efficient algorithms and data structures. This discussion covers the research software, the file structures, examples of data creation, data search, and triangle rendering codes that allow geometric surfaces to be extracted from volumetric data. The key idea behind this visualization paradigm is that various levels-of-detail are represented as differently sized hexahedral virtual voxels, which are stored in a three-dimensional kd-tree; thus the level-of-detail representa-

tion is done in voxel space instead of the traditional approach which relies on surface or geometry space decimations. This algorithm has been implemented as an integral component in the EIGEN/VR project at Sandia National Laboratories, which provides a rich environment for scientists to interactively explore and visualize the results of very large-scale simulations performed on massively parallel supercomputers.
NTIS
Extraction; Computer Programs

19990031941 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Mobile Software Testing over the Internet
Chu, H. D., Newcastle-upon-Tyne Univ., UK; Chen, J., Newcastle-upon-Tyne Univ., UK; February 1998; 26p; In English
Report No.(s): PB99--122665; TRS-622; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a novel paradigm for software testing, mobile software testing, which applies the mobile agents to software testing and can test applications on remote sites. Testing tools with information are registered with the tools broker on the testing server side. Testers on the testing client side only need to launch a mobile testing agent to remote testing servers. The mobile testing agent requests the tool broker for testing services on the users behalf. The paradigm proposed shows a way to address software testing problems in a networked environment that fits more naturally with the real world.
NTIS
Software Engineering; Computer Networks; Program Verification (Computers); Internets; Acceptability; Remote Sensors

19990031943 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Coordinated Atomic Actions as a Technique for Implementing Distributed Gamma Computation
Romanovsky, A., Newcastle-upon-Tyne Univ., UK; Zorzo, A. F., Newcastle-upon-Tyne Univ., UK; June 1998; 30p; In English
Report No.(s): PB99--122640; TRS-624; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The intentions of this paper are to discuss Co-ordinated Atomic actions and to demonstrate how they can be used in a very new application area.
NTIS
Concurrent Processing; Computation; Gamma Function; Fault Tolerance

19990031944 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK
Maps of Programs
Holt, C. M., Newcastle-upon-Tyne Univ., UK; July 1998; 18p; In English
Report No.(s): PB99--122632; TRS-625; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a view of programs that is intended to appeal to the spatial and temporal intuitions which the authors use in dealing with the real world and its inhabitants. In particular, objects are considered to be independent processes that take up space and exist over time, from the moment of their creation to that of their destruction. They have interfaces which are also objects, that have particular properties. An object is specified in terms of causal implications among its interfaces, that may involve time. The composition of two objects consists of the linking of interfaces from each object, so that the specification of the whole may be derived from the specifications of the parts using the transitivity of implication. Everything is an object or is composed of objects, from values to functions and relations, from programming variables to operating systems, from wires to synchronous or asynchronous channels between processes.
NTIS
Object-Oriented Programming; Data Links; Topology; Mapping; Computer Systems Programs

19990031951 Stanford Univ., Computer Science Dept., Stanford, CA USA
Software Development Technologies for Reactive, Real-Time, and Hybrid Systems: Summary of Research, *1 Oct. 1993 - 31 Dec. 1998*
Manna, Zohar, Stanford Univ., USA; 1998; 23p; In English
Contract(s)/Grant(s): NAG2-892; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This research is directed towards the implementation of a comprehensive deductive-algorithmic environment (toolkit) for the development and verification of high assurance reactive systems, especially concurrent, real-time, and hybrid systems. For this, we have designed and implemented the STCP (Stanford Temporal Prover) verification system. Reactive systems have an ongoing interaction with their environment, and their computations are infinite sequences of states. A large number of systems can be seen as reactive systems, including hardware, concurrent programs, network protocols, and embedded systems. Temporal logic provides a convenient language for expressing properties of reactive systems. A temporal verification methodology provides

procedures for proving that a given system satisfies a given temporal property. The research covered necessary theoretical foundations as well as implementation and application issues.
Derived from text
Computer Programming; Real Time Operation; Software Engineering; Temporal Logic; Algorithms; Sequencing

19990032137 Department of Energy, Washington, DC USA
Rapid prototyping and the ASME B5.54 standard for evaluation of machine tool performance
Lewis, G. K., Department of Energy, USA; Rhorer, D., Department of Energy, USA; Mar. 31, 1998; 7p; In English; Measurements and Standards Issues in Rapid Prototyping, USA
Report No.(s): DE98-004384; LA-UR-97-5083; CONF-9710191; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Directed Light Fabrication (DLF) process has shown feasibility for rapid fabrication of metal to full density. Structural properties equivalent to those of conventionally processed material have been achieved. The process is performed without the use of stereolithography files using a more conventional CNC approach to developing the motion path from the CAD solid model and using multi-axis positioning to deposit material in any plane, not just the horizontal plane used in many current processes. The important criteria for evaluating a solid free-form deposit were suggested and used to evaluate a part produced by DLF example presented here.
NTIS
Prototypes; Evaluation; Standards; Computer Aided Design; Computer Aided Manufacturing

19990032173 Federal Data Corp., Bethesda, MD USA
A Numerical Solver for the National Cycle Program
Binder, Michael, NYMA, Inc., USA; [1998]; 22p; In English; 23rd; Aerospace Science and Technology, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 509-10-31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NCP is a NASA/Industry Cooperative Effort to build a common system modeling capability for aerospace propulsion systems.
Derived from text
Government/Industry Relations; Propulsion System Configurations; Spacecraft Propulsion

19990032199 Department of Energy, Office of Energy Research, Washington, DC USA
Matching the high momentum modes in a truncated determinant algorithm
Duncan, A., Department of Energy, USA; Eichten, E., Department of Energy, USA; Thacker, H., Department of Energy, USA; Sep. 30, 1998; 5p; In English; 16th; Lattice Field Theory, USA
Report No.(s): DE98-059315; FNAL/C-98/283-T; CONF-980753; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Within a truncated determinant algorithm, two alternatives are discussed for including systematically the remaining ultraviolet modes. Evidence is presented that these modes are accurately described by an effective action involving only small Wilson loops.
NTIS
Algorithms; Determinants; Mathematical Models

19990032231 Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA
Software attribute visualization for high integrity software
Pollock, G. M., Department of Energy, USA; Mar. 31, 1998; 114p; In English
Report No.(s): DE98-004184; SAND-98-0359; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report documents a prototype tool developed to investigate the use of visualization and virtual reality technologies for improving software surety confidence. The tool is utilized within the execution phase of the software life cycle. It provides a capability to monitor an executing program against prespecified requirements constraints provided in a program written in the requirements specification language SAGE. The resulting Software Attribute Visual Analysis Tool (SAVAnT) also provides a technique to assess the completeness of a software specification.
NTIS
Computer Programs; Software Engineering; Visual Signals; Virtual Reality; Quality Control

19990032233 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Extend(trademark) customization: Experiences and issues
Parker, R. Y., Department of Energy, USA; Dec. 09, 1997; 21p; In English
Report No.(s): DE98-004310; LA-UR-97-5032; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Extend(trademark) simulation software is a dynamic modeling package developed by Imagine That Incorporated. The Technology Modeling and Analysis group (TSA-7) at Los Alamos National Laboratory has used Extend extensively over the past few years as one of various tools employed to perform simulation modeling and analysis. Development efforts over much of this period have made Extend a more effective and efficient tool through block customization. TSA-7 has taken advantage of the built-in capability in Extend to allow users to create new or modify existing functional blocks from which simulation models are constructed. As a result, Extend is much more effective and efficient for the group's applications. This paper summarizes block customization and simulation model development that markedly improved the utilization of the Extend software package. The material covered herein includes some background information on Extend, which is necessary for understanding the balance of the paper. Following the background, the paper addresses Extend block customization efforts, including advantages and disadvantages to customizing, and the impact customization has had on Extend modeling efforts in TSA-7. Brief descriptions of many customized blocks developed by the author are presented in the appendix.
NTIS
Mathematical Models; Computer Programs; Applications Programs (Computers)

19990032260 Joint Advanced Distributed Simulation Joint Test Force, Albuquerque, NM USA
Testing Advanced Distributed Simulation for Use in Electronic Warfare Test and Evaluation
Wright, Darrell; Harris, Clyde; Jan. 1998; 11p; In English; Prepared in cooperation with Science Applications Interrational Corp., Albuquergue, NM.
Report No.(s): AD-A359369; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The JADS JT&E program is an OSD sponsored Joint-Service test designed to determine how well an emerging technology - Advanced Distributed Simulation (ADS) - can support DoD test and evaluation (T&E) activities. The two-phase ADS test using an Electronic Warfare (EW) system will investigate the present utility of ADS for T&E, identify the critical constraints, concerns, and methodologies when using ADS for T&E; and identify the requirements that must be introduced in ADS systems if they are to support a more complete T&E capability in the future. The emphasis of the JADS EW test is not on evaluating the EW system performance in use as a test vehicle; rather, the emphasis of the test is on the performance of the ADS components and their relative contribution to EW systems T&E. The term ADS (which includes Distributed Interactive Simulation as a subset) is intended to support a mixture of live, virtual, and constructive entities. The ADS-oriented test approach will investigate numerous issues from the T&E perspective including distributed test control and analysis, network performance, relationships between data latencies, ADS induced data anomalies, use of the High Level Architecture (HLA), and Run Time Infrastructure (RTI). Time, cost, and complexity, as well as validity and credibility of the data are part of the evaluation. A series of tests have been designed which will support comparison of data and results obtained from open air range EW testing with two ADS-based tests. This paper focuses on the two ADS-based tests to evaluate the utility of Advanced Distributed Simulation (ADS) to support an Electronic Warfare system test. The paper describes the test objectives, scope, and test design process for creating a unique virtual EW test environment of linked components. Details describing the test methodology, the ADS test architecture for testing an EW system, and use of DMS0's High Level Architecture are provided.
DTIC
Electronic Warfare; Distributed Interactive Simulation; Flight Tests; Distributed Parameter Systems

19990032262 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Novel algorithm for real-time adaptive signal detection and identification
Sleefe, G. E., Department of Energy, USA; Ladd, M. D., Department of Energy, USA; Gallegos, D. E., Department of Energy, USA; Sicking, C. W., Department of Energy, USA; Erteza, I. A., Department of Energy, USA; Apr. 30, 1998; 11p; In English; 12th; Aerospace/Defense Sensing, Simulation and Controls, USA
Report No.(s): DE98-004468; SAND-98-0840C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a novel digital signal processing algorithm for adaptively detecting and identifying signals buried in noise. The algorithm continually computes and updates the long-term statistics and spectral characteristics of the background noise. Using this noise model, a set of adaptive thresholds and matched digital filters are implemented to enhance and detect signals that are buried in the noise. The algorithm furthermore automatically suppresses coherent noise sources and adapts to time-varying signal conditions. Signal detection is performed in both the time-domain and the frequency-domain, thereby permitting the detection of both broad-band transients and narrow-band signals. The detection algorithm also provides for the computation

of important signal features such as amplitude, timing, and phase information. Signal identification is achieved through a combination of frequency-domain template matching and spectral peak picking. The algorithm described herein is well suited for real-time implementation on digital signal processing hardware. This paper presents the theory of the adaptive algorithm, provides an algorithmic block diagram, and demonstrate its implementation and performance with real-world data. The computational efficiency of the algorithm is demonstrated through benchmarks on specific DSP hardware. The applications for this algorithm, which range from vibration analysis to real-time image processing, are also discussed.
NTIS
Digital Systems; Data Processing; Algorithms; Real Time Operation; Adaptation; Signal Processing; Dynamic Structural Analysis

19990032379 Science Applications International Corp., Albuquerque, NM USA
An Advanced Distributed Simulation Inclusive Test Planning Methodology
Reeves, John; Dec. 1998; 11p; In English; Presented at the International Test and Evaluation Association Moddeling and Simulation Workshop 7-10 Dec 98.
Report No.(s): AD-A359355; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The methodology described in this paper is couched in terms of operational test and evaluation (OT&E). But, as OT&E moves left on the acquisition timeline and as new systems demand ever more complex test environments, the process can benefit Development Test and Evaluation (DT&E) as well. Historically, OT&E planners have had to live with severe test asset and cost limitations. As a result, the tendency during test concept development has been to analyze the operating environment from the boffom up. Typically, the process involved identifying the set of entities in the operating environment which has direct interaction with the system under test and culling that group down to a minimum set. The historical approach resulted in a consistent collection of test limitations which are found in test report after test report, e.g., insufficient numbers and types of targets; insufficient numbers and types of friendly players; and inadequate representation of command, control, communications, intelligence, surveillance, and reconnaissance assets on friendly and opposing sides. The advantage, at the cost of test limitations, of the historical approach to test concept development and planning was that uncontrolled variables were kept to a minimum, and cause and effect relationships were relatively straightforward. That was not a trivial advantage, but it was an advantage for the analysts not the system under test (SUT) users. In combat operations the users sometimes found that factors not included in operational testing had significant bearing on the ability of a system to do its intended job.
DTIC
Computerized Simulation; Command and Control; Telecommunication

19990032387 Department of Energy, Washington, DC USA
Adaptation of the fuzzy K-nearest neighbor classifier for manufacturing automation
Karnowski, T. P., Department of Energy, USA; Geleason, S. S., Department of Energy, USA; Tobin, K. W., Department of Energy, USA; Jan. 31, 1998; 11p; In English; BIOS '98: Biomedical Optics, 1998, USA
Report No.(s): DE98-003175; ORNL/CP-96060; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The use of supervised pattern recognition technologies for automation in the manufacturing environment requires the development of systems that are easy to train and use. In general, these systems attempt to emulate an inspection or measurement function typically performed by a manufacturing engineer or technician. This paper describes a self-optimizing classification system for automatic decision making in the manufacturing environment. This classification system identifies and labels unique distributions of product defects denoted as signatures. The technique relies on encapsulating human experience through a teaching method to emulate the human response to various manufacturing situations. This has been successfully accomplished through the adaptation and extension of a feature-based, fuzzy k-nearest neighbor (k-NN) classifier that has been implemented in a pair-wise fashion. The classifier works with pair- wise combinations of the user-defined classes so that a significant reduction in feature space and problem complexity can be achieved. This k-NN implementation makes extensive use of hold-one-out results and fuzzy ambiguity information to optimize its performance. A semiconductor manufacturing case study will be presented. The technique uses data collected from in-line optical inspection tools to interpret and rapidly identify characteristic signatures that are uniquely associated with the manufacturing process. The system then alerts engineers to probable yield-limiting conditions that require attention.
NTIS
Classifiers; Classifications; Decision Making; Computer Aided Manufacturing

19990032422 Department of Energy, Washington, DC USA

Inversion based on computational simulations

Hanson, K. M., Department of Energy, USA; Cunningham, G. S., Department of Energy, USA; Saquib, S. S., Department of Energy, USA; Dec. 31, 1998; 15p; In English; Maximum Entropy and Bayesian Methods, USA

Report No.(s): DE98-006313; LA-UR-98-998; CONF-9708174; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A standard approach to solving inversion problems that involve many parameters uses gradient-based optimization to find the parameters that best match the data. The authors discuss enabling techniques that facilitate application of this approach to large-scale computational simulations, which are the only way to investigate many complex physical phenomena. Such simulations may not seem to lend themselves to calculation of the gradient with respect to numerous parameters. However, adjoint differentiation allows one to efficiently compute the gradient of an objective function with respect to all the variables of a simulation. When combined with advanced gradient-based optimization algorithms, adjoint differentiation permits one to solve very large problems of optimization or parameter estimation. These techniques will be illustrated through the simulation of the time-dependent diffusion of infrared light through tissue, which has been used to perform optical tomography. The techniques discussed have a wide range of applicability to modeling including the optimization of models to achieve a desired design goal.

NTIS

Inversions; Computerized Simulation

19990032433 Defence Science and Technology Organisation, Electronic and Surveillance Research Lab., Salisbury, Australia

A Model for Joint Software Reviews

Kingston, Gina; Oct. 1998; 43p; In English

Report No.(s): AD-A360608; DSTO-TR-0735; DODA-AR-010-661; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Joint software reviews, involving the developer and the acquirer, play an important role in Defence's acquisition of software-intensive systems. However, academic and commercial work on software reviews has focused on intra-organizational peer reviews and software inspections. This report argues that the principles which have been derived for inspections cannot be blindly applied to joint software reviews. This paper proposes a model of joint reviews, which draws on software engineering, decision and negotiation theory, and models of inspection. The model suggests that the structure and goals of the review group may significantly affect the outcome of the review. The model has also been used to suggest changes to Defence's software review process and to plan a series of studies on joint software reviews. These studies will provide additional and updated recommendations on how Defence should structure their software reviews for maximum efficiency and effectiveness.

DTIC

Computer Programs; Software Engineering

19990032494 Illinois Univ., Dept. of Civil Engineering, Urbana-Champaign, IL USA

WARP3D-Release 10.8: Dynamic Nonlinear Analysis of Solids using a Preconditioned Conjugate Gradient Software Architecture

Koppenhoefer, Kyle C., Illinois Univ., USA; Gullerud, Arne S., Illinois Univ., USA; Ruggieri, Claudio, Illinois Univ., USA; Dodds, Robert H., Jr., Illinois Univ., USA; Healy, Brian E., Exxon Production Research Company, USA; September 1998; ISSN 0069-4274; 234p; In English

Contract(s)/Grant(s): NAG2-1126

Report No.(s): UILU-ENG-95-2012; SRS-607; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report describes theoretical background material and commands necessary to use the WARP3D finite element code. WARP3D is under continuing development as a research code for the solution of very large-scale, 3-D solid models subjected to static and dynamic loads. Specific features in the code oriented toward the investigation of ductile fracture in metals include a robust finite strain formulation, a general J-integral computation facility (with inertia, face loading), an element extinction facility to model crack growth, nonlinear material models including viscoplastic effects, and the Gurson-Tver-gaard dilatant plasticity model for void growth. The nonlinear, dynamic equilibrium equations are solved using an incremental-iterative, implicit formulation with full Newton iterations to eliminate residual nodal forces. The history integration of the nonlinear equations of motion is accomplished with Newmarks Beta method. A central feature of WARP3D involves the use of a linear-preconditioned conjugate gradient (LPCG) solver implemented in an element-by-element format to replace a conventional direct linear equation solver. This software architecture dramatically reduces both the memory requirements and CPU time for very large, nonlinear solid models since formation of the assembled (dynamic) stiffness matrix is avoided. Analyses thus exhibit the numerical stability for large time (load) steps provided by the implicit formulation coupled with the low memory requirements characteristic of an explicit code.

In addition to the much lower memory requirements of the LPCG solver, the CPU time required for solution of the linear equations during each Newton iteration is generally one-half or less of the CPU time required for a traditional direct solver. All other computational aspects of the code (element stiffnesses, element strains, stress updating, element internal forces) are implemented in the element-by- element, blocked architecture. This greatly improves vectorization of the code on uni-processor hardware and enables straightforward parallel-vector processing of element blocks on multi-processor hardware.
Author
Finite Element Method; Vector Processing (Computers); Parallel Processing (Computers); Iterative Solution; Equations of Motion

19990032514 Rutherford Appleton Lab., Dept. for Computation and Information, Oxford, UK
Solution of Equality Constrained Quadratic Programming Problems Arising in Optimization
Gould, N. I. M., Rutherford Appleton Lab., UK; Hribar, M. E., Rutherford Appleton Lab., UK; Nocedal, J., Rutherford Appleton Lab., UK; Oct. 19, 1998; 34p; In English
Report No.(s): PB99-120354; RAL-TR-1998-069; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

We consider the application of the conjugate gradient method to the solution of large equality constrainted quadratic programs arising in nonlinear optimization. The approach is based on a reduced linear system and generates iterates in the null space of the constraints. Instead of computing a basis for this null space, we chose to work directly with the matrix of constraint gradients, computing projections into the null space by either a normal equations or an augmented system approach. This can yield substantial economies in both line search and trust region methods for large-scale optimization, but can also result in significant rounding errors. We propose iterative refinement techniques, as well as an adaptive reformulation of the quadratic problem, that can greatly reduce these errors without incurring in high computational overhead. Numerical results illustrating the efficiency of the proposed approaches are presented.
NTIS
Quadratic Programming; Conjugate Gradient Method; Nonlinearity

19990032559 Pennsylvania State Univ., Penn State Applied Research Lab., University Park, PA USA
Computational Modeling Program ***Final Report, 1 Oct. 1997 - 30 Sep. 1998***
Govindan, T. R., Pennsylvania State Univ., USA; Davis, Robert J., Pennsylvania State Univ., USA; 1998; 5p; In English
Contract(s)/Grant(s): NAG2-1165; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

An Integrated Product Team (IPT) has been formed at NASA Ames Research Center which has set objectives to investigate devices and processes suitable for meeting NASA requirements on ultrahigh performance computers, fast and low power devices, and high temperature wide bandgap materials. These devices may ultimately be sub-100nm feature-size. Processes and equipment must meet the stringent demands posed by the fabrication of such small devices. Until now, the reactors for Chemical Vapor Deposition (CVD) and plasma processes have been designed by trial and error procedures. Further, once the reactor is in place, optimum processing parameters are found through expensive and time-consuming experimentation. If reliable models are available that describe processes and the operation of the reactors, that chore would be reduced to a routine task while being a cost-effective option. The goal is to develop such a design tool, validate that tool using available data from current generation processes and reactors, and then use that tool to explore avenues for meeting NASA needs for ultrasmall device fabrication. Under the present grant, ARL/Penn State along with other IPT members has been developing models and computer code to meet IPT goals. Some of the accomplishments achieved during the first year of the grant are described in this report
Author
Computers; Refractory Materials; Semiconductors (Materials); Energy Gaps (Solid State); Fabrication; Models; Quantum Mechanics

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COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

19990028340 Department of Energy, Washington, DC USA
Bicriteria network design problems
Marathe, M. V., Department of Energy, USA; Ravi, R., Department of Energy, USA; Sundaram, R., Department of Energy, USA; Ravi, S. S., Department of Energy, USA; Rosenkrantz, D. J., Department of Energy, USA; Nov. 20, 1997; 29p; In English
Report No.(s): DE98-004329; LA-UR-97-5200; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors study a general class of bicriteria network design problems. A generic problem in this class is as follows: Given an undirected graph and two minimization objectives (under different cost functions), with a budget specified on the first, find a subgraph from a given subgraph class that minimizes the second objective subject to the budget on the first. They consider three different criteria -- the total edge cost, the diameter and the maximum degree of the network. Here, they present the first polynomial-time approximation algorithms for a large class of bicriteria network design problems for the above mentioned criteria. The following general types of results are presented. First, they develop a framework for bicriteria problems and their approximations. Second, when the two criteria are the same they present a black box parametric search technique. This black box takes in as input an approximation algorithm for the criterion situation and generates an approximation algorithm for the bicriteria case with only a constant factor loss in the performance guarantee. Third, when the two criteria are the diameter and the total edge costs they use a cluster based approach to devise approximation algorithms. The solutions violate both the criteria by a logarithmic factor. Finally, for the class of treewidth-bounded graphs, they provide pseudopolynomial-time algorithms for a number of bicriteria problems using dynamic programming. The authors show how these pseudopolynomial-time algorithms can be converted to fully polynomial-time approximation schemes using a scaling technique.
NTIS
Criteria; Design Analysis; Computer Networks

19990028370 Department of Energy, Office of Energy Research, Washington, DC USA
Interfacing parallel scientific applications with multiple visualization systems: The CUMULVS approach
Kohl, J. A., Department of Energy, USA; Papadopoulos, P. M., Department of Energy, USA; Mar. 31, 1998; 7p; In English; Interoperability of DOE visualization centers, USA
Report No.(s): DE98-005663; ORNL/CP-98318; CONF-980373; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As high-performance computer simulation increasingly replaces more expensive and time-consuming conventional alternatives, namely physical prototyping/experimentation, it becomes important to provide mechanisms for interacting with parallel or distributed simulation programs. Such interactive exchanges can close the loop on simulation experiments by providing visualization of intermediate results and then allowing scientists to respond by manipulating the simulation, while it is running. This type of visualization and computation steering feedback system can dramatically shorten the experimental cycle by pruning off experiments that are quickly seen to be undesirable. Further, such interaction can provide enhanced capabilities for what if analyses, even beyond what would be possible in a physical environment. This approach also introduces new forms of collaboration, by allowing multiple remote collaborators to cooperate and interact via the running simulation programs, each person exploring their own view of the data and then sharing their understanding with the group. The CUMULVS (Collaborative User Migration User Library for Visualization and Steering) system is a middleware library infrastructure that allows multiple, potentially remote, scientists to monitor and coordinate control over a parallel simulation program. Using CUMULVS, various front-end viewers can dynamically attach to a simulation to view snapshots of the ongoing computation, or manipulate (steer) parameters of the simulation, and then detach. The snapshots of intermediate data array values can be rendered using a variant of visualization systems, including AVS, Tcl/Tk, and VTK, or as simple text dumps. CUMULVS provides the interfacing between the simulation tasks and the visualization systems, and transparently handles the viewer connection protocols and the data collection required for decomposed or distributed data. CUMULVS also provides mechanisms for developing fault- tolerant applications in heterogeneous distributed computing environments.
NTIS
Data Processing; Alternatives; Control Simulation; Data Acquisition; Feedback; Protocol (Computers); Parallel Processing (Computers)

19990028603 Department of Energy, Washington, DC USA

Proactive DSA application and implementation

Draelos, T., Department of Energy, USA; Hamilton, V., Department of Energy, USA; Istrail, G., Department of Energy, USA; May 03, 1998; 19p; In English; Laboratories for the 21st Century, USA

Report No.(s): DE98-001308; SAND-97-2939C; CONF-980554; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Data authentication as provided by digital signatures is a well known technique for verifying data sent via untrusted network links. Recent work has extended digital signatures to allow jointly generated signatures using threshold techniques. In addition, new proactive mechanisms have been developed to protect the joint private key over long periods of time and to allow each of the parties involved to verify the actions of the other parties. In this paper, the authors describe an application in which proactive digital signature techniques are a particularly valuable tool. They describe the proactive DSA protocol and discuss the underlying software tools that they found valuable in developing an implementation. Finally, the authors briefly describe the protocol and note difficulties they experienced and continue to experience in implementing this complex cryptographic protocol.

NTIS

Computer Networks; Procedures; Digital Techniques; Computer Information Security

19990028635 Department of Energy, Office of Energy Research, Washington, DC USA

Scalable Networked Information Processing Environment (SNIPE)

Fagg, G. E., Department of Energy, USA; Moore, K., Department of Energy, USA; Dongarra, J. J., Department of Energy, USA; Geist, A., Department of Energy, USA; Nov. 30, 1997; 19p; In English; Supercomputing '97: High Performance Networking and Computing, 1997, USA

Report No.(s): DE98-004824; ORNL/CP-97254; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

SNIPE is a metacomputing system that aims to provide a reliable, secure, fault tolerant environment for long term distributed computing applications and data stores across the global Internet. This system combines global naming and replication of both processing and data to support large scale information processing applications leading to better availability and reliability than currently available with typical cluster computing and/or distributed computer environments.

NTIS

Fault Tolerance; Data Processing; Computer Programming

19990028645 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Graph-based network-vulnerability analysis system

Swiler, L. P., Department of Energy, USA; Phillips, C., Department of Energy, USA; Gaylor, T., Department of Energy, USA; May 03, 1998; 22p; In English; Security and Privacy, 1998, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-001486; SAND-97-3010C; CONF-980534; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper presents a graph based approach to network vulnerability analysis. The method is flexible, allowing analysis of attacks from both outside and inside the network. It can analyze risks to a specific network asset, or examine the universe of possible consequences following a successful attack. The analysis system requires as input a database of common attacks, broken into atomic steps, specific network configuration and topology information, and an attacker profile. The attack information is matched with the network configuration information and an attacker profile to create a superset attack graph. Nodes identify a stage of attack, for example the class of machines the attacker has accessed and the user privilege level he or she has compromised. The arcs in the attack graph represent attacks or stages of attacks. By assigning probabilities of success on the arcs or costs representing level of effort for the attacker, various graph algorithms such as shortest path algorithms can identify the attack paths with the highest probability of success.

NTIS

Computer Networks; Graph Theory; Network Analysis; Vulnerability; Computer Information Security

19990028791 Department of Energy, Washington, DC USA

Sandia's network for SC 1997: Supporting visualization, distributed cluster computing, and production data networking with a wide area high performance parallel asynchronous transfer mode (ATM) network

Pratt, T. J., Department of Energy, USA; Martinez, L. G., Department of Energy, USA; Vahle, M. O., Department of Energy, USA; Archuleta, T. V., Department of Energy, USA; Williams, V. K., Department of Energy, USA; May 31, 1998; 22p; In English

Report No.(s): DE98-005801; SAND-98-1154; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The advanced networking department at Sandia National Laboratories has used the annual Supercomputing conference sponsored by the IEEE and ACM for the past several years as a forum to demonstrate and focus communication and networking developments. At SC 1997, Sandia National Laboratories (SNL), Los Alamos National Laboratory (LANL), and Lawrence Livermore National Laboratory (LLNL) combined their SC 1997 activities within a single research booth under the Advance Strategic Computing Initiative (ASCI) banner. For the second year in a row, Sandia provided the network design and coordinated the networking activities within the booth. At SC 1997, Sandia elected to demonstrate the capability of the Computation Plant, the visualization of scientific data, scalable ATM encryption, and ATM video and telephony capabilities. At SC 1997, LLNL demonstrated an application, called RIPTIDE, that also required significant networking resources. The RIPTIDE application had computational visualization and steering capabilities. This paper documents those accomplishments, discusses the details of their implementation, and describes how these demonstrations support Sandia's overall strategies in ATM networking.
NTIS
Asynchronous Transfer Mode; Computer Systems Performance; Computer Techniques; Computer Networks; Data Transmission; Parallel Processing (Computers)

19990028809 Department of Energy, Office of Energy Research, Washington, DC USA
Partitioning sparse rectangular matrices for parallel processing
Kolda, T. G., Department of Energy, USA; May 31, 1998; 14p; In English; 5th; Solving irregularly structured problems in parallel, USA
Report No.(s): DE98-005713; ORNL/CP-98161; CONF-980813; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors are interested in partitioning sparse rectangular matrices for parallel processing. The partitioning problem has been well-studied in the square symmetric case, but the rectangular problem has received very little attention. They will formalize the rectangular matrix partitioning problem and discuss several methods for solving it. They will extend the spectral partitioning method for symmetric matrices to the rectangular case and compare this method to three new methods -- the alternating partitioning method and two hybrid methods. The hybrid methods will be shown to be best.
NTIS
Partitions (Mathematics); Parallel Processing (Computers); Matrices (Mathematics)

19990031900 Department of Energy, Office of Energy Research, Washington, DC USA
Efficient and flexible fault tolerance and migration of scientific simulation using CUMULVS
Kohl, J. A., Department of Energy, USA; Papadopoulos, P. M., Department of Energy, USA; May 31, 1998; 13p; In English; 2nd; Parallel and distributed systems, USA
Report No.(s): DE98-005712; ORNL/CP-98320; CONF-980805; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

CUMULVS is a middleware infrastructure for interacting with parallel scientific simulations to support online visualization and computational steering. The base CUMULVS system has been extended to provide a user-level mechanism for collecting checkpoints in a parallel simulation program. Via the same interface that CUMULVS uses to identify and describe data fields for visualization and parameters for steering, the user application can select the minimal program state necessary to restart or migrate an application task. The CUMULVS run-time system uses this information to efficiently recover fault-tolerant applications by restarting failed tasks. Application tasks can also be migrated -- even across heterogeneous architecture boundaries -- to achieve load balancing or to improve the task's locality with a required resource. This paper describes the CUMULVS interface for checkpointing, the issues faced in utilizing this interface when developing fault-tolerant and migrating applications, and the direction of future research in this area.
NTIS
Fault Tolerance; Migration; Computerized Simulation

19990032109 Department of Energy, Office of Energy Research, Washington, DC USA
S-HARP: A parallel dynamic spectral partitioner
Sohn, A., Department of Energy, USA; Simon, H., Department of Energy, USA; Jan. 31, 1998; 20p; In English; Parallel Algorithms and Architectures, USA
Report No.(s): DE98-052654; LBNL-41348; CONF-980637; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Computational science problems with adaptive meshes involve dynamic load balancing when implemented on parallel machines. This dynamic load balancing requires fast partitioning of computational meshes at run time. The authors present in this

report a fast parallel dynamic partitioner, called S-HARP. The underlying principles of S-HARP are the fast feature of inertial partitioning and the quality feature of spectral partitioning. S-HARP partitions a graph from scratch, requiring no partition information from previous iterations. Two types of parallelism have been exploited in S-HARP, fine grain loop level parallelism and coarse grain recursive parallelism. The parallel partitioner has been implemented in Message Passing Interface on Cray T3E and IBM SP2 for portability. Experimental results indicate that S-HARP can partition a mesh of over 100,000 vertices into 256 partitions in 0.2 seconds on a 64 processor Cray T3E. S-HARP is much more scalable than other dynamic partitioners, giving over 15 fold speedup on 64 processors while ParaMeTiS1.0 gives a few fold speedup. Experimental results demonstrate that S-HARP is three to 10 times faster than the dynamic partitioners ParaMeTiS and Jostle on six computational meshes of size over 100,000 vertices.
NTIS
Computation; Dynamic Loads; Computational Grids; Parallel Processing (Computers)

19990032138 Department of Energy, Washington, DC USA
HIPPI-6400: Designing for speed
Tolmie, D. E., Department of Energy, USA; Mar. 31, 1998; 25p; In English; 12th; High Performance Computing Systems and Applications, USA
Report No.(s): DE98-004383; LA-UR-97-4906; CONF-980544; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The emerging High Performance Parallel Interface 6400 Mbit/s interface (HIPPI-6400), is targeted as a local area network (LAN), or system area network (SAN), supporting data rates of 6400 Mbit/s (800 Mbyte/s). This is eight times the speed of Gigabit Ethernet. The features used, and the design choices made, for the data link and physical layers of HIPPI-6400, to achieve this unprecedented speed are the subject of this paper. HIPPI-6400 borrowed freely from other successful technologies such as ATM, Ethernet and the original HIPPI -- taking the best features of each and melding them with some new features. HIPPI-6400 is a cost effective reliable interconnect for distances up to 1 km; it intermixes large and small messages efficiently.
NTIS
Local Area Networks; Design Analysis; Cost Effectiveness; Computer Networks; Parallel Processing (Computers)

19990032420 Department of Energy, Washington, DC USA
Sparse matrix orderings for factorized inverse preconditioners
Benzi, M., Department of Energy, USA; Tuama, M., Department of Energy, USA; Dec. 31, 1998; 8p; In English; 5th; Iterative Methods, USA
Report No.(s): DE98-006328; LA-UR-98-1129; CONF-980393; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effect of reorderings on the performance of factorized sparse approximate inverse preconditioners is considered. It is shown that certain reorderings can be very beneficial both in the preconditioner construction phase and in terms of the rate of convergence of the preconditioned iteration.
NTIS
Matrices (Mathematics); Preconditioning

19990032425 Naval Postgraduate School, Monterey, CA USA
Summary of Research 1997, Department of Computer Science, *1 Jan. 1997 - 31 Dec. 1997*
Boger, Dan; Rowe, Neil C.; Jan. 1999; 82p; In English
Report No.(s): AD-A360487; NPS-09-98-006; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report contains summaries of research projects in the Department of Computer Science. A list of recent publications is also included which consists of conference presentations and publications, books, contributions to books, published journal papers, technical reports, and thesis abstracts.
DTIC
Management Information Systems; Computer Programs; Research

19990032555 Department of Energy, Office of Energy Research, Washington, DC USA

Visualization tool for parallel and distributed computing using the Lilith framework

Gentile, A. C., Department of Energy, USA; Evensky, D. A., Department of Energy, USA; Wyckoff, P., Department of Energy, USA; May 31, 1998; 12p; In English; 2nd; Parallel and distributed systems, USA

Report No.(s): DE98-052514; SAND-98-8513C; CONF-980805; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present a visualization tool for the monitoring and debugging of codes run in a parallel and distributed computing environment, called Lilith Lights. This tool can be used both for debugging parallel codes as well as for resource management of clusters. It was developed under Lilith, a framework for creating scalable software tools for distributed computing. The use of Lilith provides scalable, non-invasive debugging, as opposed to other commonly used software debugging and visualization tools. Furthermore, by implementing the visualization tool in software rather than in hardware (as available on some MPPs), Lilith Lights is easily transferable to other machines, and well adapted for use on distributed clusters of machines. The information provided in a clustered environment can further be used for resource management of the cluster. In this paper, they introduce Lilith Lights, discussing its use on the Computational Plant cluster at Sandia National Laboratories, show its design and development under the Lilith framework, and present metrics for resource use and performance.

NTIS

Computers; Parallel Processing (Computers); Program Verification (Computers)

63
CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also 54 Man/System Technology and Life Support.

19990028335 Department of Energy, Washington, DC USA

Classification of behavior using unsupervised temporal neural networks

Adair, K. L., Department of Energy, USA; Argo, P., Department of Energy, USA; Mar. 31, 1998; 9p; In English; Systems, man and cybernetics, USA

Report No.(s): DE98-004362; LA-UR-97-4802; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Adding recurrent connections to unsupervised neural networks used for clustering creates a temporal neural network which clusters a sequence of inputs as they appear over time. The model presented combines the Jordan architecture with the unsupervised learning technique Adaptive Resonance Theory, Fuzzy ART. The combination yields a neural network capable of quickly clustering sequential pattern sequences as the sequences are generated. The applicability of the architecture is illustrated through a facility monitoring problem.

NTIS

Neural Nets; Classifications

19990028818 Boeing Information, Space and Defense Systems, Seattle, WA USA

Nondestructive Evaluation for Data Fusion ***Final Report, Sep. 1995 - Apr. 1998***

Nelson, James M.; Bossi, Richard H.; Lancaster, Christy A.; May 1998; 157p; In English

Contract(s)/Grant(s): F33615-95-C-5234; AF Proj. 3153

Report No.(s): AD-A359377; D658-10844-1; AFRL-ML-WP-TR-1998-4095; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

NDE data fusion methodologies and algorithms were refined and implemented under this program and have been packaged and delivered to the Air Force in a visually programmable, object oriented application builder software package entitled INDERS 3. An important functional element of this package is ability to integrate part geometry models with associated NDT data. Three case studies were selected and conducted during the development of the package. The first case study applies to the development of a low cost manufacturing process for the Joint Strike Fighter composite wingbox. The second case study examined the effect on radar performance of maintenance and repair of the E-3 AWACS radome. The third case study applied to evaluation of B1-B weapons bay doors for in service damage. The package was implemented on a purchased Silicon Graphics workstation which was used for the case studies and was delivered to the Air Force at the conclusion of the contract. The results of the effort were presented to both industry and Air Force personnel in a series of meetings, demonstrations, and software installations.

DTIC

Nondestructive Tests; Multisensor Fusion; Algorithms

19990031885 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Contact force modeling between non-convex objects using a nonlinear damping model

Lafarge, R. A., Department of Energy, USA; Lewis, C., Department of Energy, USA; Jun. 30, 1998; 9p; In English; ADAMS user, USA

Report No.(s): DE98-005516; SAND-98-1168C; CONF-980656; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

At Sandia National Laboratories, the authors are developing the ability to accurately predict motions for arbitrary numbers of bodies of arbitrary shapes experiencing multiple applied forces and intermittent contacts. In particular, they are concerned with the simulation of systems such as part feeders or mobile robots operating in realistic environments. Preliminary investigation of commercial dynamics software packages led us to the conclude that they could use a commercial code to provide everything they needed except for the contact model. They found that ADAMS best fit the needs for a simulation package. This paper provides a technical review of a custom hierarchical distance computation engine developed at Sandia, called the C-Space Toolkit (CSTk). In addition, the authors describe an efficient contact model using a non-linear damping term developed at Ohio State. Both the CSTk and the non-linear damper have been incorporated in a simplified two-body testbed code, which is used to investigate how to correctly model the contact using these two utilities. They have incorporated this model into ADAMS SOLVER using the callable function interface. An example that illustrate the capabilities of the 9.02 release of ADAMS with the extensions is provided. NTIS

Convexity; Nonlinearity; Damping; Mathematical Models

19990031976 Wisconsin Univ., Dept. of Computer Sciences, Madison, WI USA

Machine Learning: Proceedings of the Fifteenth International Conference ***Final Report***

Shavlik, Jude, Editor, Wisconsin Univ., USA; Jul. 1998; 595p; In English; 15th; Machine Learning, 24-27 Jul. 1998, Madison, WI, USA

Contract(s)/Grant(s): N00014-98-1-0810

Report No.(s): AD-A350721; No Copyright; Avail: CASI; A25, Hardcopy; A06, Microfiche

This document contains 66 technical articles regarding international advances in the artificial intelligence subfield of machine learning.

CASI

Artificial Intelligence; Conferences; Machine Learning

19990032062 Department of Energy, Washington, DC USA

Dynamic Modeling of Physical Phenomena for PRAs using Neural Networks

Benjamin, A. S., Department of Energy, USA; Brown, N. N., Department of Energy, USA; Paez, T. L., Department of Energy, USA; Apr. 30, 1998; 8p; In English; Probabilistic Safety Assessment and Management (PSAM4), USA

Report No.(s): DE98-005779; SAND-98-0916C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In most probabilistic risk assessments, there is a set of accident scenarios that involves the physical responses of a system to environmental challenges. Examples include the effects of earthquakes and fires on the operability of a nuclear reactor safety system, the effects of fires and impacts on the safety integrity of a nuclear weapon, and the effects of human intrusions on the transport of radionuclides from an underground waste complex, and their evaluation may require the use of detailed computer codes that are very time consuming to execute. Yet, to perform meaningful probabilistic analyses, it is necessary to evaluate the responses for a large number of variations in the input parameters that describe the initial state of the system, the environments to which it is exposed, and the effects of human interaction. Because the uncertainties of the system response may be very large, it may also be necessary to perform these evaluations for various values of modeling parameters that have high uncertainties, such as material stiffnesses, surface emissivities, and ground permeabilities. The authors have been exploring the use of artificial neural networks (ANNs) as a means for estimating the physical responses of complex systems to phenomenological events such as those cited above. These networks are designed as mathematical constructs with adjustable parameters that can be trained so that the results obtained from the networks will simulate the results obtained from the detailed computer codes. The intent is for the networks to provide an adequate simulation of the detailed codes over a significant range of variables while requiring only a small fraction of the computer processing time required by the detailed codes. This enables the authors to integrate the physical response analyses into the probabilistic models in order to estimate the probabilities of various responses.

NTIS

Neural Nets; Probability Theory; Risk

19990032181 Amsterdam Univ., Netherlands

UNSUP: An Approach to Unsupervised Classification of Remote Sensing Imagery ***Final Report***

Mokken, Robert J.; Dec. 1998; 23p; In English

Contract(s)/Grant(s): N68171-95-C-9124

Report No.(s): AD-A359397; BAA-RM-99-1; R/D-7701-EN-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Multispectral remote sensing (RS) images are high-dimensional, their dimension varying from 7 (LANDSAT TM) to 256 or more for hyperspectral data (AVIRIS). A high spatial resolution leads to huge data volumes for RS datasets. Their interpretation, given the usual lack of sufficient ground knowledge, depends on feature detection, requiring efficient unsupervised classification methods. An approach is sketched using fast kd-tree algorithms, with adaptive k-NN density estimators, leading to a 4-step unsupervised classification. In the first step an adaptive, spatially biased learning sample of spectral values is drawn from an RS image to provide an optimal base for class detection. In the second step a density-based cluster analysis detects the class system, for various values of separation and sample coverage. In the third step classes are not just defined as labels but also as linear segments on their singular value decompositions. Finally, in the fourth step the full image is classified by mapping its pixels to the nearest class as spectral mixtures. A prototype was developed with Java JDK 1.1 and tested on a LANDSAT TM image of the Painted Rock reservoir. Performance was quite satisfactory. The resulting image classifications showed good discrimination and class texture.

DTIC

Image Processing; Adaptive Control; Nonparametric Statistics; Remote Sensing; Image Classification; Imagery; Pattern Recognition

19990032543 Department of Energy, Washington, DC USA

Human supervisory approach to modeling industrial scenes using geometric primitives

Luck, J. P., Department of Energy, USA; Little, C. Q., Department of Energy, USA; Roberts, R. S., Department of Energy, USA; Nov. 19, 1997; 9p; In English; Robotics and automation, 1998, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-052169; UCRL-JC-128921; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A three-dimensional world model is crucial for many robotic tasks. Modeling techniques tend to be either fully manual or autonomous. Manual methods are extremely time consuming but also highly accurate and flexible. Autonomous techniques are fast but inflexible and, with real-world data, often inaccurate. The method presented in this paper combines the two, yielding a highly efficient, flexible, and accurate mapping tool. The segmentation and modeling algorithms that compose the method are specifically designed for industrial environments, and are described in detail. A mapping system based on these algorithms has been designed. It enables a human supervisor to quickly construct a fully defined world model from unfiltered and unsegmented real-world range imagery. Examples of how industrial scenes are modeled with the mapping system are provided.

NTIS

Geometry; Robotics

64
NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

19990028490 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Fixed Point Formula of Lefschetz Type in Arakelov Geometry, 1, Statement and Proof

Koehler, K., Institut des Hautes Etudes Scientifiques, France; Roessler, D., Institut des Hautes Etudes Scientifiques, France; Nov. 1998; 68p; In English

Report No.(s): PB99-127680; IHES/M/98/76; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The authors consider arithmetic varieties endowed with an action of the group scheme of n-th roots of unity and they define equivariant arithmetic K0-theory for these varieties. They use the equivariant analytic torsion to define direct image maps in this context and prove a Riemann-Roch theorem for the natural transformation of equivariant arithmetic K0-theory induced by the restriction to the fixed point scheme; this theorem can be viewed as an analog, in the context of Arkelov geometry, of the regular case of the theorem proved by P. Baum, W. Fulton, and G. Quart in (BaFQ).

NTIS

Fixed Points (Mathematics); Geometry

19990028509 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Approximation of the Newton Step by a Defect Correction Process ***Final Report***
Arian, E., Institute for Computer Applications in Science and Engineering, USA; Batterman, A., Trier Univ., Germany; Sachs, E. W., Trier Univ., Germany; February 1999; 34p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209099; NAS 1.26:209099; ICASE-99-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, an optimal control problem governed by a partial differential equation is considered. The Newton step for this system can be computed by solving a coupled system of equations. to do this efficiently with an iterative defect correction process, a modifying operator is introduced into the system. This operator is motivated by local mode analysis. The operator can be used also for preconditioning in Generalized Minimum Residual (GMRES). We give a detailed convergence analysis for the defect correction process and show the derivation of the modifying operator. Numerical tests are done on the small disturbance shape optimization problem in two dimensions for the defect correction process and for GMRES.
Author
Optimal Control; Partial Differential Equations; Newton Methods; Convergence; Defects; Quadratic Programming; Iterative Solution; Problem Solving

19990028613 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
The Krigifier: A Procedure for Generating Pseudorandom Nonlinear Objective Functions for Computational Experimentation ***Final Report***
Trosset, Michael W., College of William and Mary, USA; February 1999; 10p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209000; NAS 1.26:209000; ICASE-IR-35; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Comprehensive computational experiments to assess the performance of algorithms for numerical optimization require (among other things) a practical procedure for generating pseudorandom nonlinear objective functions. We propose a procedure that is based on the convenient fiction that objective functions are realizations of stochastic processes. This report details the calculations necessary to implement our procedure for the case of certain stationary Gaussian processes and presents a specific implementation in the statistical programming language S-PLUS.
Author
Stochastic Processes; Nonlinearity; Optimization; Algorithms

19990028629 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Semi-orthogonal wavelets for elliptic variational problems
Hardin, D. P., Department of Energy, USA; Roach, D. W., Department of Energy, USA; Apr. 30, 1998; 15p; In English; Wavelet Conference Tangier 98, 1998, USA
Report No.(s): DE98-004760; SAND-98-0975C; CONF-980434; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this paper, the authors give a construction of wavelets which are (a) semi-orthogonal with respect to an arbitrary elliptic bilinear form a((center-dot),(center-dot)) on the Sobolev space H(sub 0)(sup 1)((0, L)) and (b) continuous and piecewise linear on an arbitrary partition of (0, L). They illustrate this construction using a model problem. They also construct alpha- orthogonal Battle-Lemarie type wavelets which fully diagonalize the Galerkin discretized matrix for the model problem with domain IR. Finally they describe a hybrid basis consisting of a combination of elements from the semi-orthogonal wavelet basis and the hierarchical Schauder basis. Numerical experiments indicate that this basis leads to robust scalable Galerkin discretizations of the model problem which remain well-conditioned independent of epsilon, L, and the refinement level K.
NTIS
Differential Equations; Wavelet Analysis; Galerkin Method; Matrices (Mathematics)

19990031959 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Results of von Neumann analyses for reproducing kernel semi-discretizations
Voth, T. E., Department of Energy, USA; Christon, M. A., Department of Energy, USA; Jun. 30, 1998; 22p; In English; 4th; Computational mechanics, USA
Report No.(s): DE98-005517; SAND-98-1195C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Reproducing Kernel Particle Method (RKPM) has many attractive properties that make it ideal for treating a broad class of physical problems. RKPM may be implemented in a mesh-full or a mesh-free manner and provides the ability to tune the method, via the selection of a dilation parameter and window function, in order to achieve the requisite numerical performance. RKPM also provides a framework for performing hierarchical computations making it an ideal candidate for simulating multi-scale problems. In order to assess the numerical performance of RKPM, detailed studies of RKPM on a series of model partial differential equations has been undertaken. The results of von Neumann analyses for RKPM semi-discretizations of one and two-dimensional, first and second-order wave equations are presented in the form of phase and group errors. Excellent dispersion characteristics are found for the consistent mass matrix with the proper choice of dilation parameter. In contrast, the influence of row-sum lumping the mass matrix is shown to introduce severe lagging phase errors. A higher-order mass matrix improves the dispersion characteristics relative to the lumped mass matrix but delivers severe lagging phase errors relative to the fully integrated, consistent mass matrix.
NTIS
Kernel Functions; Neumann Problem; Discretization (Mathematics)

19990032151 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Signatures and Higher Signatures of S(sup 1)- Quotients
Lott, J., Institut des Hautes Etudes Scientifiques, France; Jul. 1998; 40p; In English
Report No.(s): PB99-122483; IHES/M/98/58; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche
The authors define and study the signature and higher signatures of the quotient space of an S(sup 1)-action on a closed oriented manifold.
NTIS
Manifolds (Mathematics); Topology

19990032569 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Large-scale Parallel Unstructured Mesh Computations for 3D High-lift Analysis ***Final Report***
Mavriplis, Dimitri J., Institute for Computer Applications in Science and Engineering, USA; Pirzadeh, S., NASA Langley Research Center, USA; February 1999; 24p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-208999; NAS 1.26:208999; ICASE-99-9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A complete ”geometry to drag-polar” analysis capability for the three-dimensional high-lift configurations is described. The approach is based on the use of unstructured meshes in order to enable rapid turnaround for complicated geometries that arise in high-lift configurations. Special attention is devoted to creating a capability for enabling analyses on highly resolved grids. Unstructured meshes of several million vertices are initially generated on a work-station, and subsequently refined on a supercomputer. The flow is solved on these refined meshes on large parallel computers using an unstructured agglomeration multigrid algorithm. Good prediction of lift and drag throughout the range of incidences is demonstrated on a transport take-off configuration using up to 24.7 million grid points. The feasibility of using this approach in a production environment on existing parallel machines is demonstrated, as well as the scalability of the solver on machines using up to 1450 processors.
Author
Parallel Computers; Unstructured Grids (Mathematics); Computational Grids; Aerodynamic Configurations; Supercomputers

65
STATISTICS AND PROBABILITY

Includes data sampling and smoothing: Monte Carlo method; and stochastic processes.

19990028323 Purdue Univ., Dept. of Statistics, West Lafayette, IN USA
On the Performance of Subset Selection Procedures Under Normality
Gupta, Shanti S.; Miescke, Klaus J.; Jun. 1998; 25p; In English; Prepared in cooperation with Illinois Univ., Chicago, IL.
Contract(s)/Grant(s): DAAH04-95-1-0165
Report No.(s): AD-A358295; TR-98-18; ARO-32922.17-MA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
From k normal populations N(t1,t1(2)),...,N(tk,tk(2), where the means t1, ,tk in R are unknown, and the variances t1(2),...,tk(2) greater than 0 are known, independent random samples of sizes n1,...,nk, respectively, are drawn. Based on these

observations, a non-empty subset of these k populations of preferably small size has to be selected, which contains the population with the largest mean with probability of the lest P(*) at every parameter configuration. Several subset selection procedures which have been proposed in the literature are compared with Bayes selection procedures for normal priors under two natural type of loss functions. Two new subset selection procedures are considered.
DTIC
Bayes Theorem; Population Theory; Normality; Probability Theory

19990028535 Department of Energy, Washington, DC USA
Dynamic modeling of physical phenomena for probabilistic risk assessments using artificial neural networks
Benjamin, A. S., Department of Energy, USA; Paez, T. L., Department of Energy, USA; Brown, N. N., Department of Energy, USA; Jan. 31, 1998; 11p; In English; ESREL 1998: European Safety and Reliability, USA
Report No.(s): DE98-004217; SAND-98-0216C; CONF-980621; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In most probabilistic risk assessments, there is a subset of accident scenarios that involves physical challenges to the system, such as high heat rates and/or accelerations. The system's responses to these challenges may be complicated, and their prediction may require the use of long-running computer codes. to deal with the many scenarios demanded by a risk assessment, the authors have been investigating the use of artificial neural networks (ANNs) as a fast-running estimation tool. They have developed a multivariate linear spline algorithm by extending previous ANN methods that use radial basis functions. They have applied the algorithm to problems involving fires, shocks, and vibrations. They have found that within the parameter range for which it is trained, the algorithm can simulate the nonlinear responses of complex systems with high accuracy. Running times per case are less than one second.
NTIS
Physical Factors; Risk; Assessments; Neural Nets; Dynamic Models

19990031873 Rutherford Appleton Lab., Dept. for Computation and Information, Chilton, UK
Matrix Methods
Duff, I. S., Rutherford Appleton Lab., UK; Dec. 10, 1998; ISSN 1358-6254; 30p; In English; Supercomputing, Collision Processes and Applications, 14-16 Sep. 1998, Belfast, UK
Report No.(s): PB99-127441; RAL-TR-1998-076; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The authors consider techniques for the solution of linear systems and eigenvalue problems. They are concerned with large-scale applications where the matrix will be large and sparse. The authors discuss both direct and iterative techniques for the solutions of sparse equations, contrasting their strengths and weaknesses and emphasizing that combinations of both are necessary in the arsenal of the applications scientists. The authors briefly review matrix diagonalization techniques for large-scale problems.
NTIS
Matrix Methods; Matrices (Mathematics); Eigenvalues; Linear Systems

19990032130 Department of Energy, Washington, DC USA
Finite-element/progressive- lattice-sampling response surface methodology and application to benchmark probability quantification problems
Romero, V. J., Department of Energy, USA; Bankston, S. D., Department of Energy, USA; Mar. 31, 1998; 67p; In English
Report No.(s): DE98-004417; SAND-98-0567; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Optimal response surface construction is being investigated as part of Sandia discretionary (LDRD) research into Analytic Nondeterministic Methods. The goal is to achieve an adequate representation of system behavior over the relevant parameter space of a problem with a minimum of computational and user effort. A Finite Element/Lattice Sampling (FE/LS) methodology for constructing progressively refined finite element response surfaces that reuse previous generations of samples is described. Similar finite element implementations can be extended to N-dimensional problems and/or random fields and applied to other types of structured sampling paradigms, such as classical experimental design and Gauss, Lobatto, and Patterson sampling. The FE/LS model is applied in a 'decoupled' Monte Carlo analysis of two sets of probability quantification test problems. The analytic test problems, spanning a large range of probabilities and very demanding failure region geometries, constitute a good testbed for comparing the performance of various nondeterministic analysis methods. In these results, FE/LS decoupled Monte Carlo analysis required orders of magnitude less computer time than direct Monte Carlo analysis, with no appreciable loss of accuracy.

Thus, when arriving at probabilities or distributions by Monte Carlo, it appears to be more efficient to expend computer-model function evaluations on building a FE/LS response surface than to expend them in direct Monte Carlo sampling.
NTIS
Finite Element Method; Sampling; Monte Carlo Method; Computerized Simulation; Failure; Probability Theory

19990032155 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Uniform Rectifiability and Quasiminimizing Sets of Arbitrary Codimension
David, G., Institut des Hautes Etudes Scientifiques, France; Semmes, S., Institut des Hautes Etudes Scientifiques, France; May 1998; 174p; In English
Report No.(s): PB99-122277; IHES/M/98/43; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Roughly speaking, a d-dimensional subset of R(n) is minimizing if arbitrary deformations of it (in a suitable class) cannot decrease its d-dimensional volume. For quasiminimizing sets one allows the mass to decrease, but only in a controlled manner. to make this precise we follow Almgren's notion of 'restricted sets'. Graphs of Lipschitz mappings f : R(d) approaches R(n-d) are always quasiminimizing, and Almgren showed that quasiminimizing sets are rectifiable. Here we establish uniform rectifiability properties of quasiminimizing sets, which provide a more quantitative sense in which these sets behave like Lipschitz graphs.
NTIS
Set Theory; Minimal Surfaces

19990032250 Department of Energy, Office of Energy Research, Washington, DC USA
To fuse or not to fuse: Fuser versus best classifier
Rao, N. S., Department of Energy, USA; Apr. 30, 1998; 13p; In English; 12th; Aerospace/defense sensing, simulation and controls, USA
Report No.(s): DE98-005063; ORNL/CP-97084; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A sample from a class defined on a finite-dimensional Euclidean space and distributed according to an unknown distribution is given. The authors are given a set of classifiers each of which chooses a hypothesis with least misclassification error from a family of hypotheses. They address the question of choosing the classifier with the best performance guarantee versus combining the classifiers using a fuser. They first describe a fusion method based on isolation property such that the performance guarantee of the fused system is at least as good as the best of the classifiers. For a more restricted case of deterministic classes, they present a method based on error set estimation such that the performance guarantee of fusing all classifiers is at least as good as that of fusing any subset of classifiers.
NTIS
Classifiers; Error Analysis

66
SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

19990028611 Research and Technology Organization, Neuilly-sur-Seine, France
Land Operations in the Year 2020 (LO2020) ***Operations terrestres a l'horizon 2020 (LO2020)***
March 1999; 268p; In English
Report No.(s): RTO-TR-8; AC/323(SAS)TP/5; ISBN 92-837-1015-0; Copyright Waived; Avail: CASI; A12, Hardcopy; A03, Microfiche

This is the final report of the Long-Term Scientific Study on Land Forces in the Year 2020. This study identified the types of land forces and their capabilities and characteristics that will be required on the NATO battlefield in the year 2020 for warfighting and other military operations. This information provides SHAPE, and subsequently the major NATO Commanders, with a basis for long-term requirements and defence planning guidance.
Author
North Atlantic Treaty Organization (NATO); Military Operations; Warfare; Military Technology

19990031991 Department of the Air Force, Washington, DC USA
Operational Requirements Document: National Air and Space Warfare Model (NASM), 1
Sandstrom, James E., Department of the Air Force, USA; Jan. 1998; 29p; In English
Report No.(s): AD-A358533; HQ-USAF-009-93-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A general description of operational capability, security threats, shortcomings of existing systems, capabilities required, program support, force structure, schedule considerations and three attachments comprised of a requirements correlation matrix, glossary and acronym list are presented in relation to the National Air and Space Warfare Model (NASM).

CASI
Combat; Defense Program; Military Operations; Models; Operational Problems

19990032046 Minnesota Univ., School of Mathematics, Minneapolis, MN USA
Sensor Management and Nonlinear Filtering Research ***Final Report, 1 Feb. - 31 Oct. 1998***
Friedman, Avner; Kastella, Keith; Schmaedeke, Wayne; Oct. 31, 1998; 13p; In English
Contract(s)/Grant(s): F49620-98-1-0182
Report No.(s): AD-A360450; AFRL-SR-BL-TR-99-0062; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This grant is supporting development of mathematical foundations for sensor management and nonlinear filtering. The accomplishments so far are in two areas: (1) The use of Interactive Multiple Model Kalman Filters (IMMKF) with a metric called discrimination gain (DG); and (2) the use of nonlinear filtering, (NLF) in the tracking of target elevation for objects flying close to a reflecting surface. In the case of IMMKF, we demonstrate, using simulated data, that IMMKF can be used to compute the information gain when multiple sensors observe a collection of maneuvering airborne targets. In the case of NLF, we demonstrate the feasibility of using NLF methods for altitude tracking in multipath.

DTIC
Nonlinear Filters; Multisensor Fusion

67
THEORETICAL MATHEMATICS

Includes topology and number theory.

19990028834 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Trace Formula in Noncommutative Geometry and the Zeros of the Riemann Zeta Function
Connes, A., Institut des Hautes Etudes Scientifiques, France; Oct. 1998; 94p; In English
Report No.(s): PB99-122400; IHES/M/98/72; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The authors give a spectral interpretation of the critical zeros of the Riemann zeta function as an absorption spectrum, while eventual noncritical zeros appear as resonances. The authors give a geometric interpretation of the explicit formulas of number theory as a trace formula on the noncommutative space of Adele classes. This reduces the Riemann hypothesis to the validity of the trace formul and eliminates the parameter of their previous approach.

NTIS
Number Theory; Quantum Statistics

19990032121 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Invariant Currents on Limit Sets
Lott, J., Institut des Hautes Etudes Scientifiques, France; Jul. 1998; 34p; In English
Report No.(s): PB99-122509; IHES/M/98/53; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The authors relate the L(squared)-cohomology of a complete hyperbolic manifold to the invariant currents on its limit set.

NTIS
Homology; Manifolds (Mathematics); Hyperbolic Functions

19990032150 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Large Deviations for Integer Partitions

Dembo, A., Institut des Hautes Etudes Scientifiques, France; Vershik, A., Institut des Hautes Etudes Scientifiques, France; Zeitouni, O., Institut des Hautes Etudes Scientifiques, France; Jul. 09, 1998; 30p; In English

Report No.(s): PB99-122491; IHES/M/98/57; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The authors consider deviations from limit shape induced by uniformly distributed partitions (and strict partitions) of an interger n on the associated Young diagrams. The authors provide a full large deviation principle of the square root of n. The proof, based on projective limits, uses the representation of the uniform measure on partitions by means of suitably conditioned independent varibles.

NTIS

Partitions (Mathematics); Theorem Proving; Integers

19990032152 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Real Analysis, Quantitative Topology, and Geometric Complexity

Semmes, S., Institut des Hautes Etudes Scientifiques, France; Aug. 1998; 76p; In English

Report No.(s): PB99-122467; IHES/M/98/64; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Topics include: Mappings and distortion; The mathematics of good behavior, and the BMO frame of mind; Finite polyhedra and combinatorial parameterization problems; Quantitative topology, and calculus on singular spaces; and Uniform rectifiability (Smoothness of Lipschitz and bilipschitz mappings, Smoothness and uniform rectifiability, A variational problem).

NTIS

Applications of Mathematics; Analysis (Mathematics); Topology

19990032153 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Characterization Theorem for a Certain Class of Graded Lie Superalgebras

Ray, U., Institut des Hautes Etudes Scientifiques, France; Aug. 1998; 30p; In English

Report No.(s): PB99-122459; IHES/M/98/65; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

In this paper, the authors define roots in terms of the length of the root chains they give rise to, and show that any Lie superalgebra with Cartan decomposition and nondegenerate bilinear form, containing a regular element, whose roots are either of finite or infinite type, and satisfying another natural technical condition, is a direct sum of finite dimensional classical Lie superalgebras and affine Lie superalgebras with symmetrizable Cartan matrices, and GKM superalgebras. The authors defined GKM superalgebas by generators and relations and proved a generalization of the character formula for its lowest weight modules. The authors start by giving a broader definition of GKM superalgebras that includes their central extensions as in the case of a GKM algebra, it might be useful to include them; and the authors study the properties of their roots.

Author

Roots of Equations; Lie Groups

19990032154 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Some Remarks about Fractals

Semmes, S., Institut des Hautes Etudes Scientifiques, France; Aug. 1998; 106p; In English

Report No.(s): PB99-122442; IHES/M/98/67; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Recently, new families of examples of metric spaces have been found in which one can do a significant amount of 'calculus', i.e., concerning the behavior of functions and their 'derivatives' - measurements of infinitesimal oscillation - along the lines of classical Sobolev, Poincare, and isperimetric inequalities. These examples are completely distinct from Euclidean geometry, and also from the earlier examples of Carnot geometries and nilpotent Lie groups. These examples suggest rather strong shifts in outlook, for what kind of geometries are really around, what one might look for, how one might work with them, etc. In this note the authors would like to set out a few basic principles, conjectures, things to try, etc.

Author

Fractals; Metric Space; Calculus

19990032399 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Newton-Krylov methods applied to nonequilibrium radiation diffusion
Knoll, D. A., Department of Energy, USA; Rider, W. J., Department of Energy, USA; Olsen, G. L., Department of Energy, USA; Mar. 10, 1998; 6p; In English; 5th; Iterative Methods, USA
Report No.(s): DE98-006340; LA-UR-98-1076; CONF-980393; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present results of applying a matrix-free Newton-Krylov method to a nonequilibrium radiation diffusion problem. Here, there is no use of operator splitting, and Newton's method is used to convert the nonlinearities within a time step. Since the nonlinear residual is formed, it is used to monitor convergence. It is demonstrated that a simple Picard-based linearization produces a sufficient preconditioning matrix for the Krylov method, thus elevating the need to form or store a Jacobian matrix for Newton's method. They discuss the possibility that the Newton-Krylov approach may allow larger time steps, without loss of accuracy, as compared to an operator split approach where nonlinearities are not converged within a time step.
NTIS
Newton Methods; Nonequilibrium Radiation; Diffusion; Radiation Transport

19990032421 Department of Energy, Washington, DC USA
Multigrid Newton-Krylov method for flux-limited radiation diffusion
Rider, W. J., Department of Energy, USA; Knoll, D. A., Department of Energy, USA; Olson, G. L., Department of Energy, USA; Dec. 31, 1998; 5p; In English; 5th; Iterative Methods, USA
Report No.(s): DE98-006327; LA-UR-98-1075; CONF-980393; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors focus on the integration of radiation diffusion including flux-limited diffusion coefficients. The nonlinear integration is accomplished with a Newton-Krylov method preconditioned with a multigrid Picard linearization of the governing equations. They investigate the efficiency of the linear and nonlinear iterative techniques.
NTIS
Magnetic Flux; Multigrid Methods; Newton Methods; Diffusion; Diffusion Coefficient

70
PHYSICS (GENERAL)

For precision time and time interval (PTTI) see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

19990028508 NASA Lewis Research Center, Cleveland, OH USA
Fiber Optic Coupled Rayleigh Scattering Diagnostic for Point Measurement of Gas Density, Velocity and Temperature
Seasholtz, Richard G., NASA Lewis Research Center, USA; 1998; 9p; In English; 34th; Joint Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 523-21-13
Report No.(s): AIAA Paper 98-3454; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A laser technique using molecular Rayleigh scattering for density, temperature and velocity measurements in unseeded flows is described. Laser light is focused at a point in the flow under study. The Rayleigh scattered light is collected and transmitted to a planar mirror Fabry-Perot interferometer. The interferometer fringe pattern is recorded with a cooled CCD camera. Analysis of the fringe pattern gives the density, velocity, and temperature of the gas. Results from two experiments are presented. One is a low- speed heated airjet. Good agreement is shown between the temperature obtained from the Rayleigh scattering and temperatures measured with a thermocouple. The second experiment is a study of a subsonic free jet. In this experiment the laser light is transmitted to the test cell via a single-mode polarization-maintaining optical fiber. The temperature and velocity obtained from the Rayleigh scattering measurements agree well with values obtained from isentropic flow relations. The results indicate that this molecular Rayleigh scattering technique can provide temperature measurements with better than 3% accuracy and velocity measurements with better than 10 m/sec accuracy.
Author
Fiber Optics; Gas Density; Gas Temperature; Laser Outputs; Rayleigh Scattering; Velocity Measurement

19990032367 Department of Energy, Office of Energy Research, Washington, DC USA

W.E. Henry Symposium compendium: The importance of magnetism in physics and material science

Carwell, H., Department of Energy, USA; Sep. 19, 1997; 78p; In English

Report No.(s): DE98-052320; LBNL-41185; CONF-9709226-PROC; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This compendium contains papers presented at the W. E. Henry Symposium, The Importance of Magnetism in Physics and Material Science. The one-day symposium was conducted to recognize the achievements of Dr. Warren Elliot Henry as educator, scientist, and inventor in a career spanning almost 70 years. Dr. Henry, who is 88 years old, attended the symposium. Nobel Laureate, Dr. Glenn Seaborg, a friend and colleague for over 40 years, attended the event and shared his personal reminiscences. Dr. Seaborg is Associate Director-At-Large at the Lawrence Berkeley National Laboratory. The Compendium begins with three papers which demonstrate the ongoing importance of magnetism in physics and material science. Other contributions cover the highlights of Dr. Henry's career as a researcher, educator, and inventor. Colleagues and former students share insights on the impact of Dr. Henry's research in the field of magnetism, low temperature physics, and solid state physics; his influence on students as an educator; and his character, intellect and ingenuity, and passion for learning and teaching. They share a glimpse of the environment and times that molded him as a man, and the circumstances under which he made his great achievements despite the many challenges he faced.

NTIS

Conferences; Low Temperature Physics; Magnetic Properties; Magnetomechanics (Physics)

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ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see 45 Environmental Pollution.

19990028361 United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT USA

Source Methodology for Turbofan Noise Prediction (SOURCE3D Technical Documentation) ***Final Report***

Meyer, Harold D., United Technologies Corp., USA; Mar. 1999; 82p; In English

Contract(s)/Grant(s): NAS3-26618; RTOP 538-03-11

Report No.(s): NASA/CR-1998-208877; NAS 1.26:208877; E-11581; PWA-6420-104; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report provides the analytical documentation for the SOURCE3D Rotor Wake/Stator Interaction Code. It derives the equations for the rotor scattering coefficients and stator source vector and scattering coefficients that are needed for use in the TFANS (Theoretical Fan Noise Design/Prediction System). SOURCE3D treats the rotor and stator as isolated source elements. TFANS uses this information, along with scattering coefficients for inlet and exit elements, and provides complete noise solutions for turbofan engines. SOURCE3D is composed of a collection of FORTRAN programs that have been obtained by extending the approach of the earlier V072 Rotor Wake/Stator Interaction Code. Similar to V072, it treats the rotor and stator as a collection of blades and vanes having zero thickness and camber contained in an infinite, hardwall annular duct. SOURCE3D adds important features to the V072 capability-a rotor element, swirl flow and vorticity waves, actuator disks for flow turning, and combined rotor/actuator disk and stator/actuator disk elements. These items allow reflections from the rotor, frequency scattering, and mode trapping, thus providing more complete noise predictions than previously. The code has been thoroughly verified through comparison with D.B. Hanson's CUP2D two- dimensional code using a narrow annulus test case.

Author

Applications Programs (Computers); Noise Prediction; Rotors; Stators; Turbofan Engines; Wakes; Rotor Aerodynamics; Documentation; Acoustic Simulation; Vorticity

19990028489 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA

Subsonic and Supersonic Jet Noise Calculations Using PSE and DNS ***Final Report, Period ending 30 Sep. 1998***

Balakumar, P., Old Dominion Univ., USA; Owis, Farouk, Old Dominion Univ., USA; March 1999; 54p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG1-2054

Report No.(s): ODURF-182431; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Noise radiated from a supersonic jet is computed using the Parabolized Stability Equations (PSE) method. The evolution of the instability waves inside the jet is computed using the PSE method and the noise radiated to the far field from these waves is calculated by solving the wave equation using the Fourier transform method. We performed the computations for a cold supersonic

jet of Mach number 2.1 which is excited by disturbances with Strouhal numbers St=.2 and .4 and the azimuthal wavenumber m=l. Good agreement in the sound pressure level are observed between the computed and the measured (Troutt and McLaughlin 1980) results.
Author
Jet Aircraft Noise; Supersonic Jet Flow; Subsonic Flow; Stability; Far Fields; Wave Equations

19990028621 Boeing Commercial Airplane Co., Seattle, WA USA
Advanced Turbofan Duct Liner Concepts
Bielak, Gerald W., Boeing Commercial Airplane Co., USA; Premo, John W., Boeing Commercial Airplane Co., USA; Hersh, Alan S., Hersh Acoustical Engineering, Inc., USA; February 1999; 238p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-20090; RTOP 538-03-12-02
Report No.(s): NASA/CR-1999-209002; NAS 1.26:209002; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The Advanced Subsonic Technology Noise Reduction Program goal is to reduce aircraft noise by 10 EPNdB by the year 2000 relative, to 1992 technology. The improvement goal for nacelle attenuation is 25% relative to 1992 technology by 1997 and 50% by 2000. The Advanced Turbofan Duct Liner Concepts Task work by Boeing presented in this document was in support of these goals. The basis for the technical approach was a Boeing study conducted in 1993-94 under NASA/FAA contract NAS1-19349, Task 6, investigating broadband acoustic liner concepts. As a result of this work, it was recommended that linear double layer, linear and perforate triple layer, parallel element, and bulk absorber liners be further investigated to improve nacelle attenuations. NASA LaRC also suggested that ”adaptive” liner concepts that would allow ”in-situ” acoustic impedance control also be considered. As a result, bias flow and high-temperature liner concepts were also added to the investigation. The major conclusion from the above studies is that improvements in nacelle liner average acoustic impedance characteristics alone will not result in 25% increased nacelle noise reduction relative to 1992 technology. Nacelle design advancements currently being developed by Boeing are expected to add 20-40% more acoustic lining to hardwall regions in current inlets, which is predicted to result in and additional 40-80% attenuation improvement. Similar advancements are expected to allow 10-30% more acoustic lining in current fan ducts with 10-30% more attenuation expected. In addition, Boeing is currently developing a scarf inlet concept which is expected to give an additional 40-80% attenuation improvement for equivalent lining areas.
Author
Turbofan Engines; Aircraft Noise; Acoustic Ducts; Noise Reduction; Linings; Nacelles; Acoustic Attenuation

19990028654 Michigan Technological Univ., Houghton, MI USA
Signal Analysis of Helicopter Blade-Vortex-Interaction Acoustic Noise Data
Rogers, James C., Michigan Technological Univ., USA; Dai, Renshou, Michigan Technological Univ., USA; Mar. 20, 1998; 59p; In English
Contract(s)/Grant(s): NAG2-1095; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Blade-Vortex-Interaction (BVI) produces annoying high-intensity impulsive noise. NASA Ames collected several sets of BVI noise data during in-flight and wind tunnel tests. The goal of this work is to extract the essential features of the BVI signals from the in-flight data and examine the feasibility of extracting those features from BVI noise recorded inside a large wind tunnel. BVI noise generating mechanisms and BVI radiation patterns an are considered and a simple mathematical-physical model is presented. It allows the construction of simple synthetic BVI events that are comparable to free flight data. The boundary effects of the wind tunnel floor and ceiling are identified and more complex synthetic BVI events are constructed to account for features observed in the wind tunnel data. It is demonstrated that improved recording of BVI events can be attained by changing the geometry of the rotor hub, floor, ceiling and microphone. The Euclidean distance measure is used to align BVI events from each blade and improved BVI signals are obtained by time-domain averaging the aligned data. The differences between BVI events for individual blades are then apparent. Removal of wind tunnel background noise by optimal Wiener-filtering is shown to be effective provided representative noise-only data have been recorded. Elimination of wind tunnel reflections by cepstral and optimal filtering deconvolution is examined. It is seen that the cepstral method is not applicable but that a pragmatic optimal filtering approach gives encouraging results. Recommendations for further work include: altering measurement geometry, real-time data observation and evaluation, examining reflection signals (particularly those from the ceiling) and performing further analysis of expected BVI signals for flight conditions of interest so that microphone placement can be optimized for each condition.
Author
Blade-Vortex Interaction; Helicopters; Blade Slap Noise; Signal Analysis; Wind Tunnel Tests

19990031947 NASA Glenn Research Center, Cleveland, OH USA

Some Acoustic Results from the Pratt and Whitney Advanced Ducted Propulsor: Fan 1

Dittmar, James H., NASA Glenn Research Center, USA; Elliott, David M., NASA Glenn Research Center, USA; Bock, Lawrence A., Pratt and Whitney Aircraft, USA; March 1999; 82p; In English

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA/TM-1999-209049; NAS 1.15:209049; E-11582; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Noise measurements were obtained for the Advanced Ducted Propulsor (ADP) - Fan 1, with and without nacelle acoustic treatment. The fan was tested with no acoustic treatment (hard wall) and with acoustic treatment installed in three configurations in the nacelle (mid, mid plus aft, fully treated). The hard wall results showed that the radiated noise from the fan came primarily from the aft end of the nacelle. At takeoff and higher speeds, the noise measured at the inlet angles was also found to be dominated by noise from the aft end. Significant amounts of attenuation were observed with acoustic treatment installed and comparison with predictions showed the treatment gave more attenuation than predicted. Effective Perceived Noise Levels were determined for a large hypothetical 4 engine airplane. These levels showed that the installed acoustic treatment provided as much as 5 EPNdB of noise reduction. A traverse with a probe having three microphones, one above the other, showed azimuthal variations in the noise that need to be further investigated.

Author

Noise Measurement; Engine Design; Noise Reduction; Nacelles; Effective Perceived Noise Levels; Ducts

19990032037 Northrop Grumman Corp., Advanced Systems and Technology, Bethpage, NY USA

Hybrid Active/Passive Jet Engine Noise Suppression System ***Final Report***

Parente, C. A., Northrop Grumman Corp., USA; Arcas, N., Northrop Grumman Corp., USA; Walker, B. E., Hersh Acoustical Engineering, Inc., USA; Hersh, A. S., Hersh Acoustical Engineering, Inc., USA; Rice, E. J., Rice (E. J.) Consulting, USA; February 1999; 166p; In English

Contract(s)/Grant(s): NCC3-379; RTOP 538-03-11

Report No.(s): NASA/CR-1999-208875; NAS 1.26:208875; E-11570; NSL-RPT-98-002; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A novel adaptive segmented liner concept has been developed that employs active control elements to modify the in-duct sound field to enhance the tone-suppressing performance of passive liner elements. This could potentially allow engine designs that inherently produce more tone noise but less broadband noise, or could allow passive liner designs to more optimally address high frequency broadband noise. A proof-of-concept validation program was undertaken, consisting of the development of an adaptive segmented liner that would maximize attenuation of two radial modes in a circular or annular duct. The liner consisted of a leading active segment with dual annuli of axially spaced active Helmholtz resonators, followed by an optimized passive liner and then an array of sensing microphones. Three successively complex versions of the adaptive liner were constructed and their performances tested relative to the performance of optimized uniform passive and segmented passive liners. The salient results of the tests were: The adaptive segmented liner performed well in a high flow speed model fan inlet environment, was successfully scaled to a high sound frequency and successfully attenuated three radial modes using sensor and active resonator arrays that were designed for a two mode, lower frequency environment.

Author

Engine Noise; Turbomachinery; Active Control; Acoustics; Noise Reduction; Annular Ducts

19990032080 United Technologies Corp., East Hartford, CT USA

Eigenmodes of Ducted Flows With Radially-Dependent Axial and Swirl Velocity Components ***Final Report***

Kousen, Kenneth A., United Technologies Corp., USA; March 1999; 42p; In English

Contract(s)/Grant(s): NAS3-26618; RTOP 538-03-11

Report No.(s): NASA/CR-1999-208881; NAS 1.26:208881; E-11611; PWA-6420-108; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report characterizes the sets of small disturbances possible in cylindrical and annular ducts with mean flow whose axial and tangential components vary arbitrarily with radius. The linearized equations of motion are presented and discussed, and then exponential forms for the axial, circumferential, and time dependencies of any unsteady disturbances are assumed. The resultant equations form a generalized eigenvalue problem, the solution of which yields the axial wavenumbers and radial mode shapes of the unsteady disturbances. Two numerical discretizations are applied to the system of equations: (1) a spectral collocation technique based on Chebyshev polynomial expansions on the Gauss-Lobatto points, and (2) second and fourth order finite differences on uniform grids. The discretized equations are solved using a standard eigensystem package employing the QR algorithm. The

eigenvalues fall into two primary categories: a discrete set (analogous to the acoustic modes found in uniform mean flows) and a continuous band (analogous to convected disturbances in uniform mean flows) where the phase velocities of the disturbances correspond to the local mean flow velocities. Sample mode shapes and eigensystem distributions are presented for both sheared axial and swirling flows. The physics of swirling flows is examined with reference to hydrodynamic stability and completeness of the eigensystem expansions. The effect of assuming exponential dependence in the axial direction is discussed.
Author
Axial Modes; Eigenvalues; Vibration Mode; Phase Velocity; Flow Velocity; Acoustic Properties

19990032081 DYNACS Engineering Co., Inc., Brook Park, OH USA
Survey of Turbulence Models for the Computation of Turbulent Jet Flow and Noise ***Final Report***
Nallasamy, N., DYNACS Engineering Co., Inc., USA; March 1999; 40p; In English
Contract(s)/Grant(s): NAS3-98008; RTOP 538-03-11
Report No.(s): NASA/CR-1999-206592; NAS 1.26:206592; E-11568; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The report presents an overview of jet noise computation utilizing the computational fluid dynamic solution of the turbulent jet flow field. The jet flow solution obtained with an appropriate turbulence model provides the turbulence characteristics needed for the computation of jet mixing noise. A brief account of turbulence models that are relevant for the jet noise computation is presented. The jet flow solutions that have been directly used to calculate jet noise are first reviewed. Then, the turbulent jet flow studies that compute the turbulence characteristics that may be used for noise calculations are summarized. In particular, flow solutions obtained with the k-e model, algebraic Reynolds stress model, and Reynolds stress transport equation model are reviewed. Since, the small scale jet mixing noise predictions can be improved by utilizing anisotropic turbulence characteristics, turbulence models that can provide the Reynolds stress components must now be considered for jet flow computations. In this regard, algebraic stress models and Reynolds stress transport models are good candidates. Reynolds stress transport models involve more modeling and computational effort and time compared to algebraic stress models. Hence, it is recommended that an algebraic Reynolds stress model (ASM) be implemented in flow solvers to compute the Reynolds stress components.
Author
Turbulence Models; Aerodynamic Noise; Computational Fluid Dynamics; Jet Aircraft Noise; Noise Prediction; Flow Distribution; Turbulent Jets

19990032087 United Technologies Research Center, East Hartford, CT USA
Development of a Linearized Unsteady Euler Analysis with Application to Wake/Blade-Row Interactions ***Final Report***
Verdon, Joseph M., United Technologies Research Center, USA; Montgomery, Matthew D., United Technologies Research Center, USA; Chuang, H. Andrew, United Technologies Research Center, USA; March 1999; 98p; In English
Contract(s)/Grant(s): NAS3-27727; RTOP 538-03-11
Report No.(s): NASA/CR-1999-208879; NAS 1.26:208879; E-11597; UTRC-R98-4.101.0255; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

A three-dimensional, linearized, Euler analysis is being developed to provide a comprehensive and efficient unsteady aerodynamic analysis for predicting the aeroacoustic and aeroelastic responses of axial-flow turbomachinery blading. The mathematical models needed to describe nonlinear and linearized, inviscid, unsteady flows through a blade row operating within a cylindrical annular duct are presented in this report. A numerical model for linearized inviscid unsteady flows, which couples a near-field, implicit, wave-split, finite volume analysis to far-field eigen analyses, is also described. The linearized aerodynamic and numerical models have been implemented into the three-dimensional unsteady flow code, LINFLUX. This code is applied herein to predict unsteady subsonic flows driven by wake or vortical excitations. The intent is to validate the LINFLUX analysis via numerical results for simple benchmark unsteady flows and to demonstrate this analysis via application to a realistic wake/blade-row interaction. Detailed numerical results for a three-dimensional version of the 10th Standard Cascade and a fan exit guide vane indicate that LINFLUX is becoming a reliable and useful unsteady aerodynamic prediction capability that can be applied, in the future, to assess the three-dimensional flow physics important to blade-row, aeroacoustic and aeroelastic responses.
Author
Unsteady Flow; Wakes; Euler Equations of Motion; Far Fields; Annular Ducts; Finite Volume Method; Design Analysis; Aerodynamic Characteristics

19990032207 NASA Langley Research Center, Hampton, VA USA

Two-Dimensional Fourier Transform Applied to Helicopter Flyover Noise

Santa Maria, Odilyn L., NASA Langley Research Center, USA; March 1999; 64p; In English

Contract(s)/Grant(s): NCCw-0076; RTOP 581-20-31-01

Report No.(s): NASA/TM-1999-209114; NAS 1.15:209114; L-17827; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A method to separate main rotor and tail rotor noise from a helicopter in flight is explored. Being the sum of two periodic signals of disproportionate, or incommensurate frequencies, helicopter noise is neither periodic nor stationary, but possibly harmonizable. The single Fourier transform divides signal energy into frequency bins of equal size. Incommensurate frequencies are therefore not adequately represented by any one chosen data block size. A two-dimensional Fourier analysis method is used to show helicopter noise as harmonizable. The two-dimensional spectral analysis method is first applied to simulated signals. This initial analysis gives an idea of the characteristics of the two-dimensional autocorrelations and spectra. Data from a helicopter flight test is analyzed in two dimensions. The test aircraft are a Boeing MD902 Explorer (no tail rotor) and a Sikorsky S-76 (4-bladed tail rotor). The results show that the main rotor and tail rotor signals can indeed be separated in the two-dimensional Fourier transform spectrum. The separation occurs along the diagonals associated with the frequencies of interest. These diagonals are individual spectra containing only information related to one particular frequency.

Author

Fourier Transformation; Aircraft Noise; Fourier Analysis; Aerodynamic Noise; Aeroacoustics; Helicopters

19990032364 Department of Energy, Office of Energy Research, Washington, DC USA

Finite element modeling of ultrasonic waves produced by a pulsed laser

Dike, J. J., Department of Energy, USA; Mar. 31, 1998; 10p; In English; 24th; Progress in Quantitative Nondestructive Evaluation, USA

Report No.(s): DE98-052517; SAND-98-8455C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As part of an effort to apply laser ultrasonics to stress evaluation, sequential thermal and mechanical finite element analyses were used to simulate heating a region of an aluminum surface by a laser pulse and the stress waves that result. As residual or applied stresses can be related to changes in wave velocities, time-of-flight measurements may be used to determine the stresses. The goal of the effort is to improve time-of-flight measurements, and therefore resolution of the calculated stresses, using calculated waveform shapes in model-based signal processing techniques. Detailed finite element simulations of laser ultrasonics may also be used to aid development of techniques that can generate narrow band ultrasound. Because penetration of Rayleigh waves is frequency dependent, they can be used to obtain information about gradients near a surface. If the frequency of the laser generated Rayleigh waves can be controlled, laser ultrasound becomes a more useful tool for examining gradients in material properties or stresses at the surface of a part. Presented here are some preliminary finite element simulations of laser generation of ultrasound waves. Techniques for using commercial finite element codes are discussed and calculated displacement histories are presented for epicentral and same surface locations. These displacement histories are compared with results from the literature.

NTIS

Pulsed Lasers; Finite Element Method; Mathematical Models; Stress Waves; Ultrasonic Radiation; Waveforms; Signal Processing

19990032564 NASA Lewis Research Center, Cleveland, OH USA

Supersonic Jet Noise Reductions Predicted With Increased Jet Spreading Rate

Dahl, Milo D., NASA Lewis Research Center, USA; Morris, Philip J., Pennsylvania State Univ., USA; Journal of Fluids Engineering; 1998; Volume 120, pp. 471-476; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, predictions are made of noise radiation from single, supersonic, axisymmetric jets. We examine the effects of changes in operating conditions and the effects of simulated enhanced mixing that would increase the spreading rate of jet shear layer on radiated noise levels. The radiated noise in the downstream direction is dominated by mixing noise and, at higher speeds, it is well described by the instability wave noise radiation model. Further analysis with the model shows a relationship between changes in spreading rate due to enhanced mixing and changes in the far field radiated peak noise levels. The calculations predict that enhanced jet spreading results in a reduction of the radiated peak noise level.

Author

Jet Aircraft Noise; Supersonic Jet Flow; Spreading; Electromagnetic Radiation; Far Fields; Gas Jets; Shear Layers

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ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

19990028356 Department of Energy, Office of Energy Research, Washington, DC USA
Recent experiments on near-threshold electron-impact excitation of multiply charged ions
Bannister, M. E., Department of Energy, USA; Djuric, N., Department of Energy, USA; Woitke, O., Department of Energy, USA; Dunn, G. H., Department of Energy, USA; Chung, Y. S., Department of Energy, USA; Apr. 30, 1998; 13p; In English; 11th; Atomic Processes in Plasmas, USA; Sponsored by American Physical Society, USA
Report No.(s): DE98-004882; ORNL/CP-97360; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Some recent measurements of excitation of multiply charged ions by electrons studied in beam-beam experiments are highlighted. The emphasis is on absolute total cross sections measured with the merged electron-ion beams energy-loss (MEIBEL) technique, although some results obtained with the crossed-beams fluorescence method are also presented. The MEIBEL technique allows the investigation of optically-allowed and forbidden transitions with sufficient energy resolution, typically about 0.2 eV, to resolve resonance structures in the cross sections. Results from the JILA/ORNL MEIBEL experiment on dipole- allowed transitions in several ions demonstrate the success of various theoretical methods in predicting cross sections in the absence of resonances. Comparisons of R-matrix calculations and measured cross sections for spin-forbidden transitions in Mg-like Si(2+) and Ar(6+), however, show that further refinements to the theory are needed in order to more accurately predict cross sections involving significant contributions from dielectric resonance's and interactions between neighboring resonances.
NTIS
Excitation; Experimentation; Optical Measuring Instruments; Electron Impact; Ionic Collisions; Ions

19990028359 Vavilov State Optical Inst., Saint Petersburg, USSR
Transient Phenomena in Double Lambda-Atom System: Coherent Population Transfer ***Final Report***
Rozhdestvensky, Y.; Jan. 1998; 10p; In English
Contract(s)/Grant(s): F61708-97-W-0121
Report No.(s): AD-A360110; EOARD-SPC-97-4010; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In recent years there is a great interest to transient phenomena in multilevel systems. Such transient phenomena both atom wave packet coherent scattering and coherent population transfer in the atom systems have many applications both in the area of sub-doppler laser cooling and for creation of the very efficient atom wave packet beam splitter. We have to point out that the method of population transfer from one of lower levels of atom system to other one has been demonstrated previously. Its applications to atom interferometry and laser cooling below temperature of photon recoil have been proposed.
DTIC
Electromagnetic Scattering; Laser Beams; Coherent Scattering; Laser Cooling; Atomic Beams

19990028373 Department of Energy, Office of Energy Research, Washington, DC USA
Atomic and molecular physics and data activities for astrophysics at Oak Ridge National Laboratory
Jeffery, D. J., Department of Energy, USA; Kristic, P. S., Department of Energy, USA; Liu, W., Department of Energy, USA; Schultz, D. R., Department of Energy, USA; Stancil, P. C., Department of Energy, USA; Apr. 30, 1998; 7p; In English
Report No.(s): DE98-005590; ORNL/CP-98166; CONF-980439; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The atomic astrophysics group at ORNL produces, collects, evaluates, and disseminates atomic and molecular data relevant to astrophysics and actively models various astrophysical environments utilizing this information. With the advent of the World Wide Web, these data are also being placed on-line to facilitate their use by end-users. In this brief report, the group's recent activities in data production and in modeling are highlighted. For example, the authors describe recent calculations of elastic and transport cross sections relevant to ionospheric and heliospheric studies, charge transfer between metal ions and metal atoms and novel supernova nebular spectra modeling, ion-molecule collision data relevant to planetary atmospheres and comets, and data for early universe modeling.
NTIS
Atomic Physics; Astrophysics; Data Acquisition; Data Processing; Data Transmission; Metal Ions; Molecules; Planetary Atmospheres

19990028378 Department of Energy, Washington, DC USA

Improved photon production data for MCNP(trademark)

Adams, A. A., Department of Energy, USA; Frankle, S. C., Department of Energy, USA; Little, R. C., Department of Energy, USA; Apr. 30, 1998; 10p; In English; Radiation protection and shielding: technologies for the new century, USA

Report No.(s): DE98-004375; LA-UR-97-5176; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Computer simulations with MCNP are often used to obtain information from measurements of neutron induced gamma-ray spectra. For such simulations to be useful, the complicated spectra produced by a wide variety of nuclides must be reproduced, requiring high quality nuclear data. A previous assessment of the neutron induced photon production data in the MCNP data libraries indicated a need for improvement. The photon production data were often based on outdated experiments and binned in such wide energy groups as to be of limited value for some applications. This paper describes the work that is underway at Los Alamos National Laboratory to improve the photon production data for thermal neutron capture reactions. to date, high quality photon production data for each stable isotope of chlorine, chromium, iron, copper, and nickel have been obtained. The improved spectra have been incorporated into ENDF formatted evaluations and processed into corresponding MCNP data files. Similar improvements for aluminum, manganese, silicon, calcium, and vanadium are also planned. The methodology used to produce the spectra is discussed, and sample results for chlorine are presented.

NTIS

Photons; Production

19990028405 Department of Energy, Washington, DC USA

Deterministic proton transport solving a one dimensional Fokker-Planck equation

Marr, D., Department of Energy, USA; Prael, R., Department of Energy, USA; Adams, K., Department of Energy, USA; Alcouffe, R., Department of Energy, USA; Oct. 31, 1997; 15p; In English; Sponsored by American Nuclear Society, USA

Report No.(s): DE98-000822; LA-UR-97-2687; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The transport of protons through matter is characterized by many interactions which cause small deflections and slight energy losses. The few which are catastrophic or cause large angle scattering can be viewed as extinction for many applications. The transport of protons at this level of approximation can be described by a Fokker Planck Equation. This equation is solved using a deterministic multigroup differencing scheme with a highly resolved set of discrete ordinates centered around the beam direction which is adequate to properly account for deflections and energy losses due to multiple Coulomb scattering. Comparisons with LAHET for a large variety of problems ranging from 800 MeV protons on a copper step wedge to 10 GeV protons on a sandwich of material are presented. The good agreement with the Monte Carlo code shows that the solution method is robust and useful for approximate solutions of selected proton transport problems.

NTIS

Fokker-Planck Equation; Finite Difference Theory; Energy Dissipation; Coulomb Collisions; Proton Beams

19990028477 Department of Energy, Office of Energy Research, Washington, DC USA

Production of heavy flavors at the Z(sup 0) and electroweak couplings

Wagner, S. R., Department of Energy, USA; Sep. 30, 1997; 11p; In English; 7th; Heavy Flavor Physics, USA

Report No.(s): DE98-059139; SLAC-PUB-7649; CONF-970754; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The LEP experiments and SLD have measured the electroweak couplings of the b and c quarks using various tags of B and D hadron decays. The current status of these measurements is discussed, and is contrasted with other electroweak measurements at the Z(sup 0).

NTIS

Couplings; Electroweak Interactions (Field Theory); Hadrons; Particle Decay

19990028497 Department of Energy, Office of Energy Research, Washington, DC USA

Role of implantation damage in the production of silicon-on- insulator films by co-Implantation of He(+) and H(+)

Venezia, V. C., Department of Energy, USA; Agarwal, A., Department of Energy, USA; Haynes, T. E., Department of Energy, USA; Holland, O. W., Department of Energy, USA; Eaglesham, D. J., Department of Energy, USA; Jan. 31, 1998; 13p; In English; 8th; Silicon materials science and technology, USA

Report No.(s): DE98-004113; ORNL/CP-96086; CONF-980528; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent work has demonstrated that the process of silicon thin film separation by hydrogen implantation, as well as the more basic phenomenon of surface blistering, can occur at a much lower total dose when H and He are co- implanted than when H is

implanted alone. Building on that work, this paper investigates the role of implantation damage in this process by separating the contributions of gas pressure from those of damage. Three different experiments using co-implantation were designed. In the first of these experiments, H and He implants were spatially separated thereby separating the damage from each implant. The second experiment involved co-implantation of H and He at a temperature of 77 K to retain a larger amount of damage for the same gas dose. In the third experiment, Li was co-implanted with H, to create additional damage without introducing additional gas. These experiments together show that increasing the implantation damage itself hampers the formation of surface blisters, and that the increased efficiency observed for He co-implantation with H is due to the supplementary source of gas provided by the He.
NTIS
Silicon; Damage; Insulators; Ion Implantation; Hydrogen Ions; Helium Ions

19990028640 Department of Energy, Washington, DC USA
Challenges in hardening technologies using shallow-trench isolation
Shaneyfelt, M. R., Department of Energy, USA; Dodd, P. E., Department of Energy, USA; Draper, B. L., Department of Energy, USA; Flores, R. S., Department of Energy, USA; Feb. 28, 1998; 7p; In English; Nuclear and Space Radiation Effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-005039; SAND-98-0511C; CONF-980705; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Challenges related to radiation hardening CMOS technologies with shallow- trench isolation are explored. Results show that trench hardening can be more difficult than simply replacing the trench isolation oxide with a hardened field oxide.
NTIS
Radiation Hardening; Integrated Circuits; CMOS

19990028796 Department of Energy, Office of Energy Research, Washington, DC USA
Studying the spin structure of the proton using the solenoidal tracker at RHIC
Hallman, T. J., Department of Energy, USA; May 31, 1998; 11p; In English; 14th; Nuclear dynamics, USA
Report No.(s): DE98-005768; BNL-65524; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The primary goal of RHIC is to produce nuclear matter under extremes of temperature and density sufficient to excite the Quantum Chromodynamics (QCD) vacuum, resulting in the creation of a deconfined plasma of quarks and gluons. A second goal central to the RHIC scientific program is to advance the study of the spin structure of the proton significantly beyond what has been learned from deep inelastic scattering (DIS) measurements by studying spin asymmetries in strong processes involving the partonic constituents of polarized protons. After decades of being regarded as an inessential complication to the strong interaction at high energy, spin has again become a topic of considerable experimental and theoretical interest. This is largely due to the observation from DIS that the net contribution to the proton spin from the quark constituents (approximately 30%) is smaller than expected relative to the momentum carried in this sector. The RHIC accelerator will provide an unprecedented opportunity to fully explore the spin structure of the proton with high precision studies focused on measuring the spin-dependent parton distributions (valence quark, sea quark, gluon) of the proton. It is designed to operate both with high luminosity (10(exp 31)--10(exp 32) cm(exp -2) sec(exp -1)) and high polarization (approximately 70%). In addition, the energy range at RHIC ((radical)s = 200--500 GeV) is sufficiently high that spin effects in polarized proton interactions should be calculable once the spin structure of the proton is sufficiently understood. The experimental results will therefore provide a rigorous test of QCD. A further focus of the RHIC spin physics program will be to search for physics beyond the standard model. The increased sensitivity afforded by using polarized protons to study parity violation in inclusive jet production at high p(sub t) makes this exploration competitive with respect to ongoing searches using unpolarized beams.
NTIS
Protons; Matter (Physics); Solenoids; Particle Spin

19990031888 Department of Energy, Office of Energy Research, Washington, DC USA
Origins of viscoelastic dissipation in self-assembled organic monolayers
Shinn, N. D., Department of Energy, USA; Michalske, T. A., Department of Energy, USA; Apr. 30, 1998; 8p; In English, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005538; SAND-97-3129C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Although self-assembled monolayers (SAMs) are promising candidates for interfacial lubricants in micro-electromechanical systems, the relationship between the monolayer structure and its viscoelastic properties is not understood. Using Acoustic Wave Damping (AWD), the authors have measured the complex shear modulus of linear alkane thiol monolayers, HS(CH2)(n-1)CH3 denoted as C(sub n), on Au(111)-textured substrates. The AWD technique measures the elastic energy storage and dissipative loss

within a SAM adsorbed onto the electrodes of a quartz crystal microbalance. For C-12 , C-14 and C-18 SAMs, the storage modulus increases with alkane chain length, but the loss modulus exhibits no systematic correlation. to investigate the origins of energy dissipation, the authors used a new, high-sensitivity oscillator circuit to simultaneously monitor the adsorption kinetics and acoustic damping during monolayer growth from the gas phase. For both C-9 and C-12 thiols, the dissipation in the growing monolayer can be correlated with distinct two-dimensional fluid phases and the nucleation and growth of condensed-phase islands.
NTIS
Viscoelasticity; Energy Dissipation

19990032094 Department of Energy, Washington, DC USA
SOURCES-3A: A code for calculating ((alpha), n), spontaneous fission, and delayed neutron sources and spectra
Perry, R. T., Department of Energy, USA; Wilson, W. B., Department of Energy, USA; Charlton, W. S., Department of Energy, USA; Apr. 30, 1998; 11p; In English; Radiation protection and shielding: technologies for the new century, USA
Report No.(s): DE98-005278; LA-UR-98-87; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In many systems, it is imperative to have accurate knowledge of all significant sources of neutrons due to the decay of radionuclides. These sources can include neutrons resulting from the spontaneous fission of actinides, the interaction of actinide decay (alpha)-particles in ((alpha),n) reactions with low- or medium-Z nuclides, and/or delayed neutrons from the fission products of actinides. Numerous systems exist in which these neutron sources could be important. These include, but are not limited to, clean and spent nuclear fuel (UO2, ThO2, MOX, etc.), enrichment plant operations (UF6), PuF4, etc.), waste tank studies, waste products in borosilicate glass or glass-ceramic mixtures, and weapons-grade plutonium in storage containers. SOURCES-3A is a computer code that determines neutron production rates and spectra from ((alpha),n) reactions, spontaneous fission, and delayed neutron emission due to the decay of radionuclides in homogeneous media (i.e., a mixture of (alpha)-emitting source material and low-Z target material) and in interface problems (i.e., a slab of (alpha)-emitting source material in contact with a slab of low-Z target material). The code is also capable of calculating the neutron production rates due to ((alpha),n) reactions induced by a monoenergetic beam of (alpha)-particles incident on a slab of target material. Spontaneous fission spectra are calculated with evaluated half-life, spontaneous fission branching, and Watt spectrum parameters for 43 actinides. The ((alpha),n) spectra are calculated using an assumed isotropic angular distribution in the center-of-mass system with a library of 89 nuclide decay (alpha)-particle spectra, 24 sets of measured and/or evaluated ((alpha),n) cross sections and product nuclide level branching fractions, and functional (alpha)-particle stopping cross sections for Z < 106. The delayed neutron spectra are taken from an evaluated library of 105 precursors. The code outputs the magnitude and spectra of the resultant neutron source. It also provides an analysis of the contributions to that source by each nuclide in the problem.
NTIS
Computer Programs; Alpha Particles; Neutron Sources; Neutron Spectra

19990032099 Defense Advanced Research Projects Agency, Arlington, VA USA
Effects of irradiation and proton implantation on the density of mobile protons in SiO(sub 2) films
Vanheusden, K., Defense Advanced Research Projects Agency, USA; Fleetwood, D. M., Defense Advanced Research Projects Agency, USA; Schwank, J. R., Defense Advanced Research Projects Agency, USA; Shaneyfelt, M. R., Defense Advanced Research Projects Agency, USA; Meisenheimer, T. L., Defense Advanced Research Projects Agency, USA; Apr. 30, 1998; 7p; In English; Nuclear and Space Radiation Effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-004955; SAND-98-0914C; CONF-980705; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Proton implantation into the buried oxide of Si/SiO(sub 2)/Si structures does not introduce mobile protons. The cross section for capture of radiation- induced electrons by mobile protons is two orders of magnitude smaller than for electron capture by trapped holes. The data provide new insights into the atomic mechanisms governing the generation and radiation tolerance of mobile protons in SiO(sub 2). This can lead to improved techniques for production and radiation hardening of radiation tolerant memory devices.
NTIS
Silicon; Silicon Oxides; Irradiation; Implantation; Protons; Radiation Hardening; Atoms; Radiation Effects

19990032108 Department of Energy, Office of Energy Research, Washington, DC USA
B decays into light mesons
Ball, P., Department of Energy, USA; Apr. 30, 1998; 11p; In English; 33rd; Rencontres de moriond, QCD and high energy hardonic interactions, USA
Report No.(s): DE98-052804; FNAL/C-98/098-T; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author calculates the form factors describing semileptonic and penguin induced decays of B mesons into light pseudoscalar and vector mesons. The form factors are calculated from QCD sum rules on the light-cone including contributions up to twist 4, radiative corrections to the leading twist contribution and SU(3) breaking effects. The theoretical uncertainty is estimated to be tilde (15--20)%.
NTIS
Decay Rates; Light-Cone Expansion; Mesons; Computation; Numerical Analysis

19990032157 Department of Energy, Office of Energy Research, Washington, DC USA
Development of the 3rd Generation ECR ion source
Lyneis, C. M., Department of Energy, USA; Xie, Z. Q., Department of Energy, USA; Taylor, C. E., Department of Energy, USA; Sep. 30, 1997; 14p; In English; 7th; ion sources, USA
Report No.(s): DE98-052841; LBNL-40864; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The LBNL 3rd Generation ECR ion source has progressed from a concept to the fabrication of a full scale prototype superconducting magnet structure. This new ECR ion source will combine the recent ECR ion source techniques that significantly enhance the production of high charge state ions. The design includes a plasma chamber made from aluminum to provide additional cold electrons, three separate microwave feeds to allow multiple-frequency plasma heating (at 10, 14 and 18 GHz or at 6, 10 and 14 GHz) and very high magnetic mirror fields. The design calls for mirror fields of 4 T at injection and 3 T at extraction and for a radial field strength at the wall of 2.4 T. The prototype superconducting magnet structure which consists of three solenoid coils and six race track coils with iron poles forming the sextupole has been tested in a vertical dewar. After training, the sextupole magnet reached 105% of its design current with the solenoids off. With the solenoids operating at approximately 70% of their full design field, the sextuple coils operated at 95% of the design value which corresponds to a sextupole field strength at the plasma wall of more than 2.1 T.
NTIS
Ion Sources; Magnetic Mirrors; Design Analysis; Plasmas (Physics)

19990032229 Department of Energy, Office of Energy Research, Washington, DC USA
Spin probes of chemistry in zeolites
Werst, D. W., Department of Energy, USA; Trifunac, A. D., Department of Energy, USA; Sep. 30, 1997; 14p; In English
Report No.(s): DE97-054278; ANL/CHM/CP-94420; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Electron spin resonance (EPR) studies in zeolites are reviewed in which radiolysis was used to ionize the zeolite lattice, create reactive intermediates, spin label reaction products and to provide a window onto chemistry and transport of adsorbates and matrix control of chemistry. The review examines reactions of radical cations and the influence of the geometry constraints inside the zeolite, explores how zeolite model systems can be used to learn about energy and charge transfer in solids and illustrates the use of radiolysis and EPR for in situ spectroscopic studies of solid-acid catalysis. The various spin probes created inside the zeolite pores report on properties of the zeolites as well as shed light on radiolytic processes.
NTIS
Radiation Effects; Zeolites; Electron Paramagnetic Resonance; Porosity; Radicals; Chemical Effects

19990032254 Department of Energy, Washington, DC USA
Measurement bias dependence of enhanced bipolar gain degradation at low dose rates
Witczak, S. C., Department of Energy, USA; Lacoe, R. C., Department of Energy, USA; Mayer, D. C., Department of Energy, USA; Schrimpf, R. D., Department of Energy, USA; Barnaby, H. J., Department of Energy, USA; Mar. 31, 1998; 6p; In English; Nuclear and space radiation effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-005027; SAND-98-0623C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Oxide trapped charge, field effects from emitter metallization, and high level injection phenomena moderate enhanced gain degradation of lateral pnp transistors at low dose rates. Hardness assurance tests at elevated irradiation temperatures require larger design margins for low power measurement biases.
NTIS
Bias; Bipolarity; Degradation; Radiation Dosage

19990032368 Department of Energy, Office of Energy Research, Washington, DC USA

Optimal separable bases and molecular collisions

Poirier, L. W., Department of Energy, USA; Dec. 31, 1997; 150p; In English

Report No.(s): DE98-052319; LBNL-41182; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new methodology is proposed for the efficient determination of Green's functions and eigenstates for quantum systems of two or more dimensions. For a given Hamiltonian, the best possible separable approximation is obtained from the set of all Hilbert space operators. It is shown that this determination itself, as well as the solution of the resultant approximation, are problems of reduced dimensionality for most systems of physical interest. Moreover, the approximate eigenstates constitute the optimal separable basis, in the sense of self-consistent field theory. These distorted waves give rise to a Born series with optimized convergence properties. Analytical results are presented for an application of the method to the two-dimensional shifted harmonic oscillator system. The primary interest however, is quantum reactive scattering in molecular systems. For numerical calculations, the use of distorted waves corresponds to numerical preconditioning. The new methodology therefore gives rise to an optimized preconditioning scheme for the efficient calculation of reactive and inelastic scattering amplitudes, especially at intermediate energies. This scheme is particularly suited to discrete variable representations (DVR's) and iterative sparse matrix methods commonly employed in such calculations. State to state and cumulative reactive scattering results obtained via the optimized preconditioner are presented for the two-dimensional collinear H + H2 (yields) H2 + H system. Computational time and memory requirements for this system are drastically reduced in comparison with other methods, and results are obtained for previously prohibitive energy regimes.

NTIS

Procedures; Atomic Collisions; Molecular Collisions; Eigenvectors; Green"S FUNCTIONS

19990032376 Department of Energy, Office of Energy Research, Washington, DC USA

New ideas to improve searches for (mu)(+) (r-arrow) e(+)(gamma)

Cooper, M. D., Department of Energy, USA; Nov. 30, 1997; 12p; In English; Front end of the muon colliders, USA

Report No.(s): DE98-005285; LA-UR-98-121; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Searching for decays that change total lepton family number is an excellent method to explore potential physics beyond the Standard Model because those processes are predicted to be zero except when new physics is present. Essentially all extensions of the Standard Model that introduce new, heavy particles predict the existence of these rare decays, though the most probable channel is highly model dependent. Recently, the prejudice has grown within the physics community that supersymmetry is an extension that is likely to be related to nature. Barbieri, Hall, and Strumia show that rare decays are signatures for grand unified supersymmetry and calculate the rates for (mu)(+) (r-arrow) e(+)(gamma) and related processes for a wide range of parameters of these models. They conclude that (mu)(+) (r-arrow) e(+) (gamma) has the largest rate by more than two orders of magnitude, and it ranges between the current experimental limit and 10(exp -14). Hence, there is continuing interest in the community for an experiment that could have a sensitivity near 10(exp -14). Lessons are drawn from the experience of the MEGA experiment in searching for (mu)(+) to e(+)(gamma). In light of that experience, some ideas are evaluated regarding new searches that might take place in the ERA of a source of low-energy muons associated with a muon collider.

NTIS

Muons; Gamma Rays

19990032404 Department of Energy, Office of Energy Research, Washington, DC USA

Physics with Low Energy Hadrons

Guttierez, G., Department of Energy, USA; Littenberg, L., Department of Energy, USA; Oct. 31, 1997; 20p; In English; Kaon, Muon and Neutrino Physics and the Future at High Energy Accelerator Research Organization (KEK), USA

Report No.(s): DE98-004990; BNL-65395; FNAL/C-98/115; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The prospects for low energy hadron physics at the front end of a muon collider (FMC) are discussed. The FMC, as conceived for the purposes of this workshop, is pretty close to a classical idea of a kaon factory. There is an order of magnitude advantage of the FMC front end over the AGS for K(sup (-)) and (anti p) production below 5 GeV/c.

NTIS

Hadrons; Particle Energy; Particle Collisions; Muons

19990032405 Department of Energy, Office of Energy Research, Washington, DC USA

Recent Developments on the STAR Detector System at RHIC

Wieman, H., Department of Energy, USA; Adams, D. L., Department of Energy, USA; Added, N., Department of Energy, USA; Dec. 31, 1997; 7p; In English

Report No.(s): DE98-004989; BNL-65384; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The STAR detector system is designed to provide tracking, momentum analysis and particle identification for many of the mid-rapidity charged particles produced in collisions at the RHIC collider. A silicon vertex detector (SVT) provides three layers of tracking near the interaction point. This is followed by the main time projection chamber (TPC), which continues tracking out to 200 cm radial distance from the interaction region. The detector design also includes an electromagnetic calorimeter, various trigger detectors, and radial TPCs in the forward region. The entire system is enclosed in a 0.5 T solenoid magnet. A progress report is given for the various components of the STAR detector system. The authors report on the recent developments in the detector proto-typing and construction, with an emphasis on the main TPC, recent TPC cosmic ray testing and shipping to Brookhaven National Laboratory.

NTIS

Particle Production; Particle Collisions; Particle Interactions; Charged Particles

19990032406 Department of Energy, Office of Energy Research, Washington, DC USA

PHENIX Experiment at RHIC

Morrison, D. P., Department of Energy, USA; Akiba, Y., Department of Energy, USA; Alford, O., Department of Energy, USA; Dec. 31, 1997; 7p; In English; Quart Matter, 1997, USA

Report No.(s): DE98-004988; BNL-65385; ORNL/CP-97189; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The primary goals of the heavy-ion program of the PHENIX collaboration are the detection of the quark-gluon plasma and the subsequent characterization of its physical properties. to address these aims, PHENIX will pursue a wide range of high energy heavy-ion physics topics. The breadth of the physics program represents the expectation that it will require the synthesis of a number of measurements to investigate the physics of the quark-gluon plasma. The broad physics agenda of the collaboration is also reflected in the design of the PHENIX detector itself, which is capable of measuring hadrons, leptons and photons with excellent momentum and energy resolution. PHENIX has chosen to instrument a selective acceptance with multiple detector technologies to provide very discriminating particle identification abilities. Additionally, PHENIX will take advantage of RHIC's capability to collide beams of polarized protons with a vigorous spin physics program, a subject covered in a separable contribution to these proceedings.

NTIS

High Energy Interactions; Plasmas (Physics)

19990032409 Department of Energy, Office of Energy Research, Washington, DC USA

Structure of Neutron-rich Nuclei

Nazarewicz, W., Department of Energy, USA; Nov. 30, 1997; 18p; In English; Fission and Properties of Neutron-Rich Neclei, USA

Report No.(s): DE98-004980; ORNL/CP-97160; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

One of the frontiers of today's nuclear science is the 'journey to the limits': of atomic charge and nuclear mass, of neutron-to-proton ratio, and of angular momentum. The new data on exotic nuclei are expected to bring qualitatively new information about the fundamental properties of the nucleonic many-body system, the nature of the nuclear interaction, and nucleonic correlations at various energy-distance scales. In this talk, current developments in nuclear structure of neutron-rich nuclei are discussed from a theoretical perspective.

NTIS

Nuclei (Nuclear Physics); Nuclear Structure

19990032537 Department of Energy, Washington, DC USA

Efficient single scatter electron Monte Carlo

Svatos, M. M., Department of Energy, USA; Rathkopf, J. A., Department of Energy, USA; Nov. 03, 1997; 8p; In English; 5th; Computational math, USA

Report No.(s): DE98-052092; UCRL-JC-128882; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A single scatter electron Monte Carlo code (SSMC), CREEP, has been written which bridges the gap between existing transport methods and modeling real physical processes. CREEP simulates ionization,elastic and bremsstrahlung events individually.

Excitation events are usually treated with an excitation- only stopping power, although simulation of individual excitation events is possible. Agreement of these quantities with experimental values is generally distribution functions (PDFs) to describe the phase space of a single electron emerging from a sphere of a given material and radius. A library of data sets for such spheres (or ”kugels”) is being computed for a variety of incident energies, material types, and sizes. The final goal of this work is to achieve extremely accurate transport results with an efficiency that is similar to that of condensed history methods.
NTIS
Monte Carlo Method; Scattering; Electrons

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NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see 93 Space Radiation.

19990028357 Department of Energy, Washington, DC USA
Self-consistent methods in nuclear structure physics
Dobaczewski, J., Department of Energy, USA; Nov. 30, 1997; 14p; In English; 17th; Innovative Computational Methods in Nuclear Many-Body Problems, USA
Report No.(s): DE98-004838; ORNL/CP-97237; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present a very brief description of the Hartree Fock method in nuclear structure physics, discuss the numerical methods used to solve the self-consistent equations, and analyze the precision and convergence properties of solutions. As an application, they present results pertaining to quadrupole moments and single-particle quadrupole polarizations in superdeformed nuclei with approximately 60 A.
NTIS
Nuclear Structure; Hartree Approximation; Procedures; Numerical Analysis

19990028372 Department of Energy, Office of Energy Research, Washington, DC USA
What invariant one-particle multiplicity distributions and two-particle correlations are telling us about relativistic heavy-ion collisions
Nix, J. R., Department of Energy, USA; Strottman, D., Department of Energy, USA; Hecke, H. W., Department of Energy, USA; Schlei, B. R., Department of Energy, USA; Sullivan, J. P., Department of Energy, USA; Feb. 28, 1998; 11p; In English; 14th; Nuclear Dynamics, USA
Report No.(s): DE98-005645; LA-UR-98-170; CONF-980239; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have used a nine-parameter expanding source model that includes special relativity, quantum statistics, resonance decays, and freeze-out on a realistic hypersurface in spacetime to analyze in detail invariant (pi)(sup +), K(sup +), and K(sup -) one-particle multiplicity distributions and (pi) (sup +) and (pi)(sup (minus)) two-particle correlations in nearly central collisions of Pb + Pb at p(sub lab)/A = 158 GeV/c. These studies confirm an earlier conclusion for nearly central collisions of Si + Au at p(sub lab)/A = 14.6 GeV/c that the freeze-out temperature is less than 100 meV and that both the longitudinal and transverse collective velocities -- which are anti- correlated with the temperature -- are substantial. The authors also reconciled their current results with those of previous analyses that yielded a much higher freeze-out temperature of approximately 140 meV for both Pb + Pb collisions at p(sub lab)/A = 158 GeV/c and other reactions. One type of analysis was based upon the use of a heuristic equation that neglects relativity to extrapolate slope parameters to zero particle mass. Another type of analysis utilized a thermal model in which there was an accumulation of effects from several approximations. The future should witness the arrival of much new data on invariant one-particle multiplicity distributions and two- particle correlations as functions of bombarding energy and/or size of the colliding nuclei. The proper analysis of these data in terms of a realistic model could yield accurate values for the density, temperature, collective velocity, size, and other properties of the expanding matter as it freezes out into a collection of noninteracting hadrons. A sharp discontinuity in the value of one or more of these properties could conceivably be the long-awaited signal for the formation of a quark-gluon plasma or other new physics.
NTIS
Quantum Statistics; Mathematical Models; Resonance; Lead (Metal); Ionic Collisions

19990028379 Department of Energy, Office of Energy Research, Washington, DC USA

Modeling (p,xn) reactions producing proton-rich nuclides for radioactive ion beam studies

Chadwick, M. B., Department of Energy, USA; Young, P. G., Department of Energy, USA; Mar. 31, 1998; 7p; In English; Radiation protection and shielding: technologies for the new century, USA

Report No.(s): DE98-004374; LA-UR-97-5173; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Over the last few years, an intense worldwide interest has grown in the use of radioactive ion beams (RIB) to study the properties of nuclei far from stability. The relatively recent technological developments that have enabled the production of high-quality radioactive beams promise to lead to a renaissance in nuclear structure and nuclear reaction physics, as well as nuclear astrophysics. Group T-2 at Los Alamos has been working with US Nuclear Reaction Data Network Radioactive Ion Beam Task Force to address RIB nuclear data needs. The current focus is nuclear data needed to guide the choice of targets for the production of various radioactive product species using the isotope-separation on line (ISOL) method; future work will include the study of RIB nuclear reaction and structure physics. Laboratories that are undertaking RIB studies with the ISOL method in the US are principally Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL).

NTIS

Nuclear Reactions; Protons; Nuclides; Radioactivity; Ion Beams

19990028469 Department of Energy, Office of Energy Research, Washington, DC USA

Neutral pion production in nucleus-nucleus collisions at 158 and 200 GeV/ nucleon

Plasil, F., Department of Energy, USA; Feb. 28, 1998; 11p; In English; 14th; Nuclear Dynamics, USA

Report No.(s): DE98-005587; ORNL/CP-98199; CONF-980239; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two years ago, at the 12th Winter Workshop on Nuclear Dynamics held here in Snowbird, the authors presented WA80 limits on direct photon production in 200- GeV (sup 32)S + Au collisions. It was found that the results were consistent (within 1(sigma)) with the absence of an excess of photons over those that can be accounted for by the two-photon decay branches of (pi)(sup 0) and (eta) mesons and by the small photon contributions from other radiative decays. They are in the process of finalizing the direct-photon production results from collisions of lead nuclei at 158 GeV/nucleon. The author briefly discusses the status of the analysis and gives some preliminary results at the end of this talk. However, most of this presentation is concerned with a very different aspect of the photon measurements: distributions of neutral pions. In contrast to direct photons which probe initial collision conditions, hadrons, such as neutral pions, interact strongly and decouple late in the reaction evolution and, thus, provide information concerning the system at freeze out. Transverse momentum spectra at low and intermediate p(sub T) relate to thermodynamic and hydrodynamic descriptions of the hot, dense systems. In addition, the high- p(sub T) region reflects the hard-scattering regime and may help one understand initial-state particle production by forming a bridge to proton-proton and proton-nucleus results. It follows that it is essential that the (pi)(sup 0) measurements cover a large p(sub T) range.

NTIS

Nuclear Interactions; Photons; Pions; Scattering; Conferences

19990028484 Department of Energy, Office of Energy Research, Washington, DC USA

Strangeness production in relativistic nuclear collisions

Odyniec, G. J., Department of Energy, USA; Jan. 31, 1998; 17p; In English; Quark Matter '97, 1997, USA

Report No.(s): DE98-052652; LBNL-41336; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A review of strange particle production in heavy ion collisions from AGS to SPS energies is presented. Implications of the newest developments in understanding the collision dynamics and the role of strange particle production in the search for a new phase of matter, in both experimental and theoretical sectors, are discussed.

NTIS

Ionic Collisions; Strangeness; Heavy Ions

19990028518 Department of Energy, Office of Energy Research, Washington, DC USA

Multi-parton loop amplitudes and next-to-leading order jet cross-sections

Bern, Z., Department of Energy, USA; Dixon, L., Department of Energy, USA; Kosower, D. A., Department of Energy, USA; Signer, A., Department of Energy, USA; Feb. 28, 1998; 19p; In English; QCD Corrections and New Physics, USA

Report No.(s): DE98-059194; SLAC-PUB-7749; CERN-TH-98-39; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors review recent developments in the calculation of QCD loop amplitudes with several external legs, and their application to next-to-leading order jet production cross-sections. When a number of calculational tools are combined

together--helicity, color and supersymmetry decompositions, plus unitarity and factorization properties--it becomes possible to compute multi-parton one-loop QCD amplitudes without ever evaluating analytically standard one-loop Feynman diagrams. One-loop helicity amplitudes are now available for processes with five external partons (ggggg, q(anti q)ggg and q(anti q)q (anti q)(prime) g), and for an intermediate vector boson V (equivalent-to) (gamma) (sup *), Z, W plus four external partons (V q(anti q) and V q(anti q)q(prime) (anti q)(prime)). Using these amplitudes, numerical programs have been constructed for the next-to-leading order corrections to the processes p(anti p) (r-arrow) 3 jets (ignoring quark contributions so far) and e(sup +)e(sup (minus)) (r-arrow) 4 jets.
NTIS
Quantum Chromodynamics; Amplitudes; Computation

19990028812 Department of Energy, Office of Energy Research, Washington, DC USA
Electronic excitation in transmission of relativistic H(sup -) ions through thin foils
Reinhold, C. O., Department of Energy, USA; Kuerpick, P., Department of Energy, USA; Burgdoerfer, J., Department of Energy, USA; Yoshida, S., Department of Energy, USA; Gervais, B., Department of Energy, USA; May 07, 1998; 15p; In English; 4th; Swift heavy ions in matter, 1998, USA
Report No.(s): DE98-005661; ORNL/CP-98338; CONF-980564; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe a theoretical model to study the transmission of relativistic H(sup -) ions through thin carbon foils. The approach is based on a Monte Carlo solution of the Langevin equation describing electronic excitations of the atoms during the transport through the foil. Calculations for the subshell populations of outgoing hydrogen atoms are found to be in good agreement with recent experimental data on an absolute scale and show that there exists a propensity for populating extreme Stark states.
NTIS
Transmission; Hydrogen Ions; Foils (Materials); Carbon; Atomic Excitations

19990031896 Department of Energy, Washington, DC USA
Introduction to the theory and analysis of resolved (and unresolved) neutron resonances via SAMMY
Larson, N. M., Department of Energy, USA; Feb. 28, 1998; 47p; In English; Nuclear reaction data and nuclear reactors: physics, design and safety, USA; Sponsored by International Atomic Energy Agency, Austria
Report No.(s): DE98-005673; ORNL/CP-98397; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Neutron cross-section data are important for two distinct purposes: First, they provide insight into the nature of matter, thus assisting in the understanding of fundamental physics. Second, they are needed for practical applications (e.g., for calculating when and how a reactor will become critical, or how much shielding is needed for storage of nuclear materials, and for medical applications). Neutron cross section data in the resolved-resonance region are generally obtained by time-of-flight experiments, which must be carefully analyzed if they are to be properly understood and utilized. In this paper, important features of the analysis process are discussed, with emphasis on the particular techniques used in the analysis code SAMMY. Other features of the code are also described; these include such topics as calculation of group cross sections (including covariance matrices), generation and fitting of integral quantities, and extensions into the unresolved-resonance region and higher energy regions.
NTIS
Neutrons; Resonance; Data Processing

19990031969 Department of Energy, Office of Energy Research, Washington, DC USA
D-Zero Detector upgrade and jet energy scale
Sep. 30, 1998; 9p; In English; 29th; ICHEP 1998: High energy physics, 1998, USA
Report No.(s): DE98-059314; FNAL/C-98/268-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A major detector upgrade project is presently underway for the D0 experiment in preparation for Run 2 of the Fermilab Tevatron collider scheduled to begin in the year 2000. The upgrade is driven by the D0 Run 2 physics goals and by the higher event rates and backgrounds expected in the new high luminosity environment. A general overview of the D0 upgrade is given in the first part of this report. The second part describes the calibration of jets observed with the D0 detector at the transverse energy and pseudorapidity range E(sub T) > 8 GeV and (vert-bar)(eta)(vert-bar) < 3.
NTIS
Radiation Detectors; General Overviews; Jets

19990031980 Department of Energy, Office of Energy Research, Washington, DC USA

Estimates of vertex tagging efficiencies at a muon collider Higgs factory

King, B. J., Department of Energy, USA; Mar. 31, 1998; 9p; In English

Report No.(s): DE98-004436; BNL-65309; CAP-208-MUON-98C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Measurement of the branching ratios (BR) of the Higgs boson would be an important goal of a future s-channel muon collider Higgs factory. This paper derives quick, heuristic estimates of the expected tagging efficiencies and purities for the 3 main decay modes of a light, Standard Model Higgs: H yields b(anti b), H yields tau(anti tau) and H yields c(anti c). These estimates should be useful as input to theoretical assessments of the physics capabilities of Higgs factory muon colliders. The vertex tagging methods are similar for b(anti b)-bar events and c(anti c)-bar events and these two modes are treated together in the second section. The tau(bar tau) mode is then discussed in a separate section, before ending with a short conclusion section.

NTIS

Estimates; Bosons; Muons; Theoretical Physics; Efficiency; Storage Rings (Particle Accelerators); Radiation Counters

19990031981 Department of Energy, Office of Energy Research, Washington, DC USA

Neutrino physics at a muon collider

King, B. J., Department of Energy, USA; Feb. 28, 1998; 18p; In English

Report No.(s): DE98-004435; BNL-65282; CAP-206-MUON-98C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper gives an overview of the neutrino physics possibilities at a future muon storage ring, which can be either a muon collider ring or a ring dedicated to neutrino physics that uses muon collider technology to store large muon currents. After a general characterization of the neutrino beam and its interactions, some crude quantitative estimates are given for the physics performance of a muon ring neutrino experiment (MURINE) consisting of a high rate, high performance neutrino detector at a 250 GeV muon collider storage ring. The second section describes neutrino production from a muon storage rings and gives expressions for event rates in general purpose and long baseline detectors. This is followed by a section outlining a serious design constraint for muon storage rings: the need to limit the radiation levels produced by the neutrino beam. The following two sections describe a general purpose detector and the experimental reconstruction of interactions in the neutrino target then, finally, the physics capabilities of a MURINE are surveyed.

NTIS

Neutrino Beams; Neutrinos; Collision Parameters; Storage Rings (Particle Accelerators); Muons

19990032030 Department of Energy, Office of Energy Research, Washington, DC USA

W boson physics at the Fermilab Tevatron Collider

Madaras, R., Department of Energy, USA; Sep. 30, 1998; 11p; In English; 18th; Physics in collision, USA

Report No.(s): DE98-058876; FNAL/C-98-257-E; CONF-9806106; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent results from the Collider Detector at Fermilab (CDF) and D0 Experiments at the Fermilab Tevatron Collider are presented for the W and Z boson production cross sections, the W boson width, rare W boson decays, trilinear gauge boson couplings, and the W boson mass.

NTIS

Bosons; Detectors

19990032042 International Atomic Energy Agency, Vienna, Austria

International Atomic Energy Agency *Annual Report, 1997*

Jul. 1998; 82p; In English

Report No.(s): PB99-129249; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Agency's fortieth anniversary year was marked by progress in substantive areas-and by reflection on past achievements and future challenges as the Agency moves into another decade of its history under the leadership of a new Director General. In the year under review nuclear energy continued to make a significant contribution to meeting the global demand for electricity and, in this regard, the Agency continued to act as a forum for assessing experience and sharing ideas on national and international developments.

NTIS

Electricity; Nuclear Electric Power Generation

19990032044 National Inst. of Standards and Technology, Center for Neutron Research, Gaithersburg, MD USA

Materials Science and Engineering Laboratory, NIST Center for Neutron Research: Programs and Accomplishments, *1998*

Clutter, L. K., National Inst. of Standards and Technology, USA; Jan. 1999; 90p; In English

Report No.(s): PB99-117939; NISTIR-6251; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The report summarizes research results for the programs that use the facilities at the NIST Center for Neutron Research (NCNR) for the period from October 1997 through September 1998. The programs range from the use of thermal and cold neutron beams for studies of the structure and dynamics of materials to nuclear physics and neutron standards to sample irradiations for activation analysis. The NCNR is a national user facility, which served more than 1300 participants during the year, including scientists and engineers from 57 companies, 92 universities, and 38 other government agencies in the USA.

NTIS

Laboratories; Nuclear Research

19990032064 Department of Energy, Office of Energy Research, Washington, DC USA

Preliminary Analysis of Gain Measurements at the HFBR Liquid Hydrogen Moderator

Ludewig, H., Department of Energy, USA; Aronson, A., Department of Energy, USA; Todosow, M., Department of Energy, USA; Passell, L., Department of Energy, USA; Wildgruber, U., Department of Energy, USA; May 31, 1998; 9p; In English; Cold Moderation for Pulsed Neutron Sources, USA

Report No.(s): DE98-005759; BNL-65525; CONF-9709256; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The High Flux Beam Reactor (HFBR) is a 60 MW steady state neutron source. As part of the facility a cold neutron source is included in one of the beam tubes (H-9). The arrangement of this source is shown in Figure 1, which shows the reactor core, beam tube H-9, and the cold source with its attached helium cooling lines and hydrogen feed lines. The liquid hydrogen chamber is in the shape of an oblate spheroid and has a volume of 1.466 liters, and an aspect ratio of 1:3. Aluminum is used as the material of construction. The wall thickness of the chamber varies, with the thinnest value being on the flatter parts of the oblate spheroid. This design minimizes the amount of metal in the direction of the neutron beam of interest. Gain is defined as the ratio of the flux at a specific wave length leaking from the front face of the cold source, with and without the liquid hydrogen present. Measurements of the gain were made at several wavelength for the HFBR cold source. The change in the neutron spectrum at a particular wave length is a strong function of the scattering kernel of the moderator. Thus, these measurements can be used as integral data to validate calculational models and scattering kernel data for liquid hydrogen, and shed light on the actual mixture of ortho/para hydrogen in the cold source. Two scattering kernels for each of the states of liquid hydrogen (ortho and para) were available at the beginning of the study. The total scattering cross section for each of these are shown. The two ortho kernels are seen to have significant difference between the two cross sections at lower energies or longer wavelengths. This difference implies a similar difference in the scattering kernel. In the following analysis both para-hydrogen kernels and only one ortho-hydrogen kernel will be used. In addition, a free proton gas kernel (no molecular binding) will be used for comparison purposes.

NTIS

High Flux Beam Reactors; Cold Neutrons; Neutron Sources; Neutron Beams

19990032095 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA

New probability table treatment in MCNP for unresolved resonances

Carter, L. L., Department of Energy, USA; Little, R. C., Department of Energy, USA; Hendricks, J. S., Department of Energy, USA; MacFarlane, R. E., Department of Energy, USA; Apr. 30, 1998; 10p; In English; Radiation protection and shielding: technologies for the new century, USA

Report No.(s): DE98-005277; LA-UR-98-26; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An upgrade for MCNP has been implemented to sample the neutron cross sections in the unresolved resonance range using probability tables. These probability tables are generated with the cross section processor code NJOY, by using the evaluated statistical information about the resonances to calculate cumulative probability distribution functions for the microscopic total cross section. The elastic, fission, and radiative capture cross sections are also tabulated as the average values of each of these partials conditional upon the value of the total. This paper summarizes how the probability tables are utilized in this MCNP upgrade and compares this treatment with the approximate smooth treatment for some example problems.

NTIS

Probability Distribution Functions; Probability Theory; Resonance

19990032107 Department of Energy, Office of Energy Research, Washington, DC USA

Measurement of time-dependent B(sup 0)-(anti B)(sup 0) flavor oscillation at CDF

Ribon, A., Department of Energy, USA; Apr. 30, 1998; 6p; In English; High Energy Physics, USA

Report No.(s): DE98-052805; FNAL/C-98/100-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The time dependence of B(sup 0)-(anti B)(sup 0) oscillations has been studied using several techniques by the CDF experiment at Fermilab. The data comprise 110 pb(sup (minus)1) of p(anti p) collisions at (radical)s = 1.8 TeV. Preliminary measurements of the B(sup 0)-(anti B)(sup 0) oscillation frequency ((Delta)m(sub d)) will be presented.

NTIS

Time Dependence; Mesons; Collisions; Oscillations

19990032110 Department of Energy, Office of Energy Research, Washington, DC USA

Departure from the hadronic scenario at CERN SPS

Odyniec, G., Department of Energy, USA; Jan. 31, 1998; 21p; In English; Relativistic Aspects of Nuclear Physics, 1997, USA

Report No.(s): DE98-052651; LBNL-41298; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A review of results from heavy ion experiments at CERN SPS is presented, with an emphasis on the data from Pb induced interactions. Special focus is put on the most significant surprises: anomalous J/(Psi) suppression, change in the spectral shapes of e(sup +)e(sup -) mass distributions in the vector meson domain, and enhanced strange hadron production. Implications of these findings for understanding collision dynamics and, in particular, their role in the search for the new phase of matter, are discussed.

NTIS

Experimentation; Hadrons; Synchrotrons; Heavy Ions

19990032111 Department of Energy, Office of Energy Research, Washington, DC USA

R-parity violation and sneutrino resonances at muon colliders

Feng, J. L., Department of Energy, USA; Jan. 31, 1998; 10p; In English; Front end of the muon colliders, USA

Report No.(s): DE98-052650; LBNL-41253; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In supersymmetric models with R-parity violation, sneutrinos may be produced as channel resonances at (mu)(sup +)(mu)(sup (minus)) colliders. The authors demonstrate that, for R-parity violating couplings as low as 10(sup -4), sneutrino resonances may be observed and may be exploited to yield high precision SUSY parameter measurements. The excellent beam energy resolution of muon colliders may also be used to resolve MeV level splitting between CP-even and CP-odd sneutrino mass eigenstates.

NTIS

Particle Collisions; Parity; Muons; Couplings

19990032139 Department of Energy, Office of Energy Research, Washington, DC USA

Thick-target neutron, gamma-ray, and radionuclide production for protons below 12 MeV on nickel and carbon beam-stops

Chadwick, M. B., Department of Energy, USA; Young, P. G., Department of Energy, USA; Wilson, W. B., Department of Energy, USA; Mar. 31, 1998; 11p; In English; Sponsored by American Nuclear Society, USA

Report No.(s): DE98-004379; LA-UR-97-5014; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Nuclear model calculations using the GNASH code are described for protons below 12 MeV incident on nickel and carbon isotopes, for beam stop design in the Los Alamos Accelerator Production of Tritium Low Energy Demonstration Accelerator (LEDA) project. The GNASH calculations apply Hauser-Feshbach and preequilibrium reaction theories and can make use of precalculated direct reaction cross sections to low-lying residual nucleus states. From calculated thin target cross sections, thick target 6.7 MeV and 12 MeV proton-induced production of neutrons, gamma rays, and radionuclides are determined. Emission spectra of the secondary neutrons and gamma rays are also determined. The model calculations are validated through comparisons with experimental thin- and thick-target measurements. The results of this work are being utilized as source terms in MCNP analyses for LEDA.

NTIS

Neutrons; Gamma Rays; Carbon Isotopes; Targets; Radioactive Isotopes; Design Analysis

19990032403 Department of Energy, Office of Energy Research, Washington, DC USA

Event Generator Overview

Pang, Y., Department of Energy, USA; Dec. 31, 1997; 14p; In English; Quark Matter, 1997, USA

Report No.(s): DE98-004991; BNL-65351; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Due to their ability to provide detailed and quantitative predictions, the event generators have become an important part of studying relativistic heavy ion physics and of designing future experiments. In this talk, the author will briefly summarize recent progress in developing event generators for the relativistic heavy ion collisions.
NTIS
Heavy Ions; Ionic Collisions; Generators

19990032407 Department of Energy, Office of Energy Research, Washington, DC USA
Au + Au Reactions at the AGS: Experiments E866 and E917
Ogilvie, C. A., Department of Energy, USA; Ahle, L., Department of Energy, USA; Akiba, Y., Department of Energy, USA; Dec. 31, 1997; 14p; In English
Report No.(s): DE98-004987; BNL-65376; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Particle production and correlation functions from Au+Au reactions have been measured as a function of both beam energy (2 - -10.7 AGeV) and impact parameter. These results are used to probe the dynamics of heavy-ion reactions, confront hadronic models over a wide range of conditions and to search for the onset of new phenomena.
NTIS
Particle Production; High Energy Interactions; Nuclear Reactions; Gold

19990032408 Department of Energy, Office of Energy Research, Washington, DC USA
Neutrino Physics at Muon Colliders
King, B. J., Department of Energy, USA; Mar. 31, 1998; 11p; In English
Report No.(s): DE98-004983; BNL-65449; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
An overview is given of the neutrino physics potential of future muon storage rings that use muon collider technology to produce, accelerate and store large currents of muons. After a general characterization of the neutrino beam and its interactions, some crude quantitative estimates are given for the physics performance of a muon ring neutrino experiment (MURINE) consisting of a high rate, high performance neutrino detector at a 250 GeV muon collider storage ring.
NTIS
Storage Rings (Particle Accelerators); Particle Interactions; Neutrinos; Muons

19990032511 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Integral data analysis for resonance parameters determination
Larson, N. M., Department of Energy, USA; Leal, L. C., Department of Energy, USA; Derrien, H., Department of Energy, USA; Sep. 30, 1997; 37p; In English
Report No.(s): DE98-054253; ORNL/TM-13495; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Neutron time-of-flight experiments have long been used to determine resonance parameters. Those resonance parameters have then been used in calculations of integral quantities such as Maxwellian averages or resonance integrals, and results of those calculations in turn have been used as a criterion for acceptability of the resonance analysis. However, the calculations were inadequate because covariances on the parameter values were not included in the calculations. In this report an effort to correct for that deficiency is documented: (1) the R-matrix analysis code SAMMY has been modified to include integral quantities of importance, (2) directly within the resonance parameter analysis, and (3) to determine the best fit to both differential (microscopic) and integral (macroscopic) data simultaneously. This modification was implemented because it is expected to have an impact on the intermediate-energy range that is important for criticality safety applications.
NTIS
Resonance; Neutrons

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OPTICS

Includes light phenomena; and optical devices. For lasers see 36 Lasers and Masers.

19990028326 Hebrew Univ., Jerusalem Israel
Development Novel Subwavelength Light Sources and Lasers ***Final Report***
Lewis, Aaron; Oct. 1998; 11p; In English
Contract(s)/Grant(s): DAAL03-92-G-0021
Report No.(s): AD-A358340; ARO-29050.1-PH; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the help of the support we have received from the USA Advanced Research Projects Agency through the USA Army our laboratory has pioneered lensless near-field optics. The optical resolution that has been achieved with this novel advance has already carried optics to a new frontier of resolution in the range of tens of nanometers. These studies have indicated that the ultimate resolution that could be achieved with this new direction in optics could even approach the dimension of a single atom or molecule. Thus, the barrier of optical resolution has been broken by the revolution that has occurred as a result of the development of near-field optical imaging. Near-field optics elegantly bridges both exciting fundamental research and a wide variety of practical applications. These applications portend a relatively transparent integration of near-field optical technology with currently available far-field optical techniques to overcome the solid brick wall of resolution that many of these optical applications now experience.
DTIC
Optics; Near Fields; Lasers

19990028375 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Novel photon detection based on electronically-induced stress in silicon
Datskos, P. G., Department of Energy, USA; Rajic, S., Department of Energy, USA; Egert, C. M., Department of Energy, USA; Datskou, I., Department of Energy, USA; Apr. 30, 1998; 11p; In English
Report No.(s): DE98-004901; ORNL/CP-97596; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The feasibility of microcantilever-based optical detection is demonstrated. Specifically, the authors report here on an evaluation of laboratory prototypes that are based on commercially available microcantilevers. In this work, optical transduction techniques were used to measure microcantilever response to photons and study the electronic stress in silicon microcantilevers, and their temporal and photometric response. The photo-generation of free charge carriers (electrons, holes) in a semiconductor gives rise to photo-induced (electronic) mechanical strain. The excess charge carriers responsible for the photo-induced stress, were produced via photon irradiation from a diode laser with wavelength (lambda) = 780 nm. The authors found that for silicon, the photo-induced stress results in a contraction of the crystal lattice due to the presence of excess electron-hole-pairs. In addition, the photo-induced stress is of opposite direction and about four times larger than the stress resulting from direct thermal excitation. When charge carriers are generated in a short time, a very rapid deflection of the microcantilever is observed (response time (approximately) (micro)s).
NTIS
Silicon; Stresses; Feasibility Analysis; Photometry; Detection; Photometers

19990028751 F and S, Inc., Blacksburg, VA USA
Optical Fiber-Based Corrosion Sensors for Aging Aircraft
Elster, Jennifer L., F and S, Inc., USA; Greene, Jonathan A., F and S, Inc., USA; Jones, Mark E., F and S, Inc., USA; Bailey, Tim A., F and S, Inc., USA; Lenahan, Shannon M., F and S, Inc., USA; Perez, Ignacio, Naval Air Warfare Center, USA; The Second Joint NASA/FAA/DoD Conference on Aging Aircraft; January 1999, Pt. 2, pp. 716-721; In English; See also 19990028721
Contract(s)/Grant(s): N68335-97-C-0093; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Optical fiber corrosion sensors are being developed to address the high service costs associated with current structural maintenance procedures of civilian and military assets. A distributed optical fiber sensor system will help reduce the costs associated with corrosion damage and extend the lifetime of existing structures. Annual national losses in time, labor, materials and systems has been estimated in the billions of dollars. Additional costs arise from system downtime that results from disassembly procedures necessary to locate corrosion damage in remote locations. Furthermore, the potential to damage other system parts during maintenance is increased when disassembly and reassembly occurs. The development of on-line optical fiber sensors capable of detecting corrosion would eliminate a significant portion of the maintenance costs. We present recent test results using optical fiber long-period grating (LPG) corrosion sensors. With the appropriate coating, the sensors can be designed to detect moisture, pH, metal-ions, nitrides, or sulfides in otherwise inaccessible regions of the aircraft. The LPG sensors can be rendered immune to temperature cross-sensitivity, multiplexed along a single fiber, and can be demodulated using a simple, low-cost spectrum analyzer.
Author
Sensors; Optical Fibers; Aircraft Structures; Nondestructive Tests; Corrosion; Detection

19990032035 NASA Glenn Research Center, Cleveland, OH USA

Simultaneous Optical Measurements of Axial and Tangential Steady-State Blade Deflections

Kurkov, Anatole P., NASA Glenn Research Center, USA; Dhadwal, Harbans S., Integrated Fiber Optic Systems, Inc., USA; March 1999; 10p; In English; Turbo Expo '99, 7-10 Jun. 1999, Indianapolis, IN, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA/TM-1999-209051; NAS 1.15:209051; E-11587; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Currently, the majority of fiber-optic blade instrumentation is being designed and manufactured by aircraft-engine companies for their own use. The most commonly employed probe for optical blade deflection measurements is the spot probe. One of its characteristics is that the incident spot on a blade is not fixed relative to the blade, but changes depending on the blade deformation associated with centrifugal and aerodynamic loading. While there are geometrically more complicated optical probe designs in use by different engine companies, this paper offers an alternate solution derived from a probe-mount design feature that allows one to change the probe axial position until the incident spot contacts either a leading or a trailing edge. by tracing the axial position of either blade edge one is essentially extending the deflection measurement to two dimensions, axial and tangential. The blade deflection measurements were obtained during a wind tunnel test of a fan prototype.

Author

Optical Measurement; Aerodynamic Loads; Centrifugal Force; Wind Tunnel Tests; Fiber Optics; Turbomachinery

19990032106 Department of Energy, Office of Energy Research, Washington, DC USA

Derivation of aberration coefficients for single-element plane-symmetric reflecting systems using Mathematica(trademark)

McKinney, W. R., Department of Energy, USA; Palmer, C., Department of Energy, USA; Sep. 30, 1997; 12p; In English; Sponsored by International Society for Optical Engineering, USA

Report No.(s): DE98-052839; LBNL-40849; LSBL-416; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The definition of the generalized optical path function for a grating or mirror with a single plane of symmetry is reviewed. The generalized optical path function is then expanded in a series of wavefront aberration terms using only a few lines of code in the Mathematica(trademark) scientific programming environment. The use of the algebraic capabilities of the Mathematica(trademark) environment allows straightforward calculation of aberration coefficients that would normally require considerable effort if undertaken by paper and pencil. In addition, the derivation can be carried out to higher order aberration terms, limited only by the capabilities of the computer platform used.

NTIS

Symmetry; Programming Environments; Optical Paths; Optical Equipment

75
PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see90 Astrophysics.

19990028320 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA

Turbulent fluctuations in the main core of TFTR plasmas with negative magnetic shear

Mazzucato, E., Department of Energy, USA; Beer, M. A., Department of Energy, USA; Bell, M. G., Department of Energy, USA; Batha, S. H., Department of Energy, USA; Sep. 30, 1997; 9p; In English; 16th; Fusion Energy, USA; Sponsored by International Atomic Energy Agency, Austria

Report No.(s): DE98-000588; ORNL/CP-94620; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Turbulent fluctuations in plasmas with reversed magnetic shear have been investigated in TFTR. Under intense auxiliary heating, these plasmas are observed to bifurcate into two states with different transport properties. In the state with better confinement, it has been found that the level of fluctuations is very small throughout most of the region with negative shear. By contrast, the state with lower confinement is characterized by large bursts of fluctuations which suggest a competition between the driving and the suppression of turbulence. These results are consistent with the suppression of turbulence by the E x B velocity shear.

NTIS

Plasma Drift; Turbulent Flow; Reactor Cores; Tokamak Devices; Variations

19990028325 Boston Coll., Dept. of Physics, Chestnut Hill, MA USA

Generation and Amplification of Radiation in Millimeter/Submillimeter Range through Current Driven Plasma Instabilities in Modulated Lower Dimensional Solid State Systems ***Final Report, Apr. 1994 - Mar. 1998***

Sep. 1998; 9p; In English

Contract(s)/Grant(s): DAAH04-94-G-0052

Report No.(s): AD-A358302; ARO-32577.5-PH; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have introduced and studied new promising systems, which could lead to experimental verification and device applications of current driven plasma instabilities in lower dimensional solid state systems. These are: periodically modulated systems, quasi-1D bounded systems, and bounded systems with slab geometry. An interactive program for experimental verification of our results has been set-up with the Technical University, Vienna, Austria. The periodically modulated systems require significantly lower drift velocities compared to uniform systems to produce the plasma instabilities, bringing them within reach of experimental verification. In the bounded systems, with proper injection and extraction of carriers to maintain the desired non-equilibrium distribution, we obtain strong plasma instabilities, with a good chance for experimental observation. Possibility of population inversion in these latter structures is inferred by comparing our calculated I-V curves with the experimental curves. A decisive test for plasma instability in these structures is to look for radiation in the predicted frequency range. Such experiments, using bow-tie antennas, are planned for the near future. New formalisms were developed for the calculation of plasma instabilities in bounded systems (Energy Level Pairs Formalism), interlevel transport (self energy in random phase approximation), and extraction rates (transfer matrix poles).

DTIC

Millimeter Waves; Submillimeter Waves; Quantum Wires; Solid State; Magnetohydrodynamic Stability; Amplification

19990028328 Department of Energy, Washington, DC USA

Magnetic compression/magnetized target fusion (MAGO/MTF), an update

Kirkpatrick, R. C., Department of Energy, USA; Lindemuth, I. R., Department of Energy, USA; Mar. 31, 1998; 26p; In English; 2nd; Current trends in international fusion research: review and assessment, USA

Report No.(s): DE98-004249; LA-UR-97-4896; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Magnetized Target Fusion (MTF) was reported in two papers at the First Symposium on Current Trends in International Fusion Research. MTF is intermediate between two very different mainline approaches to fusion: Inertial Confinement Fusion (ICF) and magnetic confinement fusion (MCF). The only US MTF experiments in which a target plasma was compressed were the Sandia National Laboratory 'Phi targets'. Despite the very interesting results from that series of experiments, the research was not pursued, and other embodiments of MTF concept such as the Fast Liner were unable to attract the financial support needed for a firm proof of principle. A mapping of the parameter space for MTF showed the significant features of this approach. The All-Russian Scientific Research Institute of Experimental Physics (VNIIEF) has an on-going interest in this approach to thermonuclear fusion, and Los Alamos National Laboratory (LANL) and VNIIEF have done joint target plasma generation experiments relevant to MTF referred to as MAGO (transliteration of the Russian acronym for magnetic compression). The MAGO II experiment appears to have achieved on the order of 200 eV and over 100 KG, so that adiabatic compression with a relatively small convergence could bring the plasma to fusion temperatures. In addition, there are other experiments being pursued for target plasma generation and proof of principle. This paper summarizes the previous reports on MTF and MAGO and presents the progress that has been made over the past three years in creating a target plasma that is suitable for compression to provide a scientific proof of principle experiment for MAGO/MTF.

NTIS

Magnetic Compression; Targets; Controlled Fusion; Inertial Confinement Fusion; Plasmas (Physics)

19990028329 Department of Energy, Washington, DC USA

Radiation environments produced by plasma Z-pinch stagnation on central targets

Brownell, J. H., Department of Energy, USA; Bowners, R. L., Department of Energy, USA; McLenithan, K. D., Department of Energy, USA; Peterson, D. L., Department of Energy, USA; Nov. 30, 1997; 38p; In English; 39th, USA; Sponsored by American Physical Society, USA

Report No.(s): DE98-004247; LA-UR-97-4840; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A goal of modern pulsed-power technology is the development of an intense, megajoule level source of soft x-rays for use in high-energy density physics experiments. Since 1980 experimental facilities, theoretical concepts, computational tools, and diagnostics have been developed that place pulsed- power at the threshold of performing experiments of great interest to the applied physics community. In this paper the 'Flying Radiation Case' approach will be presented and its predicted performance on Sandia National Laboratory's Z-Machine (M.K. Matzen, Phys. Plasmas 4, 1519 (1997)) is described. The effects of instability

growth in the plasma during the implosion, its reassembly on a central cushion, and the plasma interactions with shaped electrodes are considered.
NTIS
Zeta Pinch; Targets; Plasmas (Physics); X Ray Sources

19990028330 Department of Energy, Washington, DC USA
Evidence of plasma fluctuations and their effect on the growth of stimulated Brillouin and stimulated Raman scattering in laser plasmas
Montgomery, D. S., Department of Energy, USA; Fernandez, J. C., Department of Energy, USA; Cobble, J. A., Department of Energy, USA; Nov. 30, 1997; 27p; In English; 39th, USA; Sponsored by American Physical Society, USA
Report No.(s): DE98-004244; LA-UR-97-4830; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The reflectivity levels of stimulated Brillouin scattering (SBS) in recent large scale length laser plasma experiments is much lower than expected for conditions where the convective gain exponent is expected to be large. Long wavelength velocity fluctuations caused during the plasma formation process, or by parametric instabilities themselves, have been proposed as a mechanism to detune SBS in these experiments and reduce its gain. Evidence of large velocity fluctuation levels is found in the time-resolved SBS spectra from these experiments, and correlates with observed changes in the reflectivity of both SBS and stimulated Raman scattering (SRS). The authors present evidence of fluctuations which increase as the plasma density systematically increases, and discuss their effect on the growth of parametric instabilities.
NTIS
Brillouin Effect; Raman Spectra; Laser Plasmas; Variations

19990028365 Department of Energy, Office of Energy Research, Washington, DC USA
Helium-cooled blanket design of the low aspect ratio reactor
Wong, C. P., Department of Energy, USA; Baxi, C. B., Department of Energy, USA; Reis, E. E., Department of Energy, USA; Cerbone, R., Department of Energy, USA; Cheng, E. T., Department of Energy, USA; Mar. 31, 1998; 25p; In English; Fusion Power Plant Design, USA
Report No.(s): DE98-005690; GA-A22828; CONF-980374; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An aggressive low aspect ratio scoping fusion reactor design indicated that a 2 GW(e) reactor can have a major radius as small as 2.9 m resulting in a device with competitive cost of electricity at 49 mill/kWh. One of the technology requirements of this design is a high performance high power density first wall and blanket system. A 15 MPa helium-cooled, V-alloy and stagnant LiPb breeder first wall and blanket design was utilized. Due to the low solubility of tritium in LiPb, there is the concern of tritium migration and the formation of V-hydride. to address these issues, a lithium breeder system with high solubility of tritium has been evaluated. Due to the reduction of blanket energy multiplication to 1.2, to maintain a plant Q of > 4, the major radius of the reactor has to be increased to 3.05 m. The inlet helium coolant temperature is raised to 436 C in order to meet the minimum V-alloy temperature limit everywhere in the first wall and blanket system. to enhance the first wall heat transfer, a swirl tape coolant channel design is used. The corresponding increase in friction factor is also taken into consideration. to reduce the coolant system pressure drop, the helium pressure is increased from 15 to 18 MPa. Thermal structural analysis is performed for a simple tube design. With an inside tube diameter of 1 cm and a wall thickness of 1.5 mm, the lithium breeder can remove an average heat flux and neutron wall loading of 2 and 8 MW/m(2), respectively. This reference design can meet all the temperature and material structural design limits, as well as the coolant velocity limits. Maintaining an outlet coolant temperature of 650 C, one can expect a gross closed cycle gas turbine thermal efficiency of 45%. This study further supports the use of helium coolant for high power density reactor design.
NTIS
Coolants; Helium; Cooling Systems; Controlled Atmospheres; Design Analysis; Structural Analysis; Thermonuclear Reactions

19990028366 Department of Energy, Office of Energy Research, Washington, DC USA
Monte Carlo impurity transport modeling in the D3-D transport
Evans, T. E., Department of Energy, USA; Finkenthal, D. F., Department of Energy, USA; Apr. 30, 1998; 19p; In English; 11th; Atomic Processes in Plasmas, USA
Report No.(s): DE98-005689; GA-A22831; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A description of the carbon transport and sputtering physics contained in the Monte Carlo Impurity (MCI) transport code is given. Examples of statistically significant carbon transport pathways are examined using MCI's unique tracking visualizer and a mechanism for enhanced carbon accumulation on the high field side of the divertor chamber is discussed. Comparisons between

carbon emissions calculated with MCI and those measured in the D3-D tokamak are described. Good qualitative agreement is found between 2D carbon emission patterns calculated with MCI and experimentally measured carbon patterns. While uncertainties in the sputtering physics, atomic data, and transport models have made quantitative comparisons with experiments more difficult, recent results using a physics based model for physical and chemical sputtering has yielded simulations with about 50% of the total carbon radiation measured in the divertor. These results and plans for future improvement in the physics models and atomic data are discussed.
NTIS
Monte Carlo Method; Carbon; Simulation; Charge Carriers; Charged Particles

19990028368 Department of Energy, Office of Energy Research, Washington, DC USA
Fueling efficiency of pellet injection on D3-D
Baylor, L. R., Department of Energy, USA; Jernigan, T. C., Department of Energy, USA; Maingi, R., Department of Energy, USA; Lasnier, C. J., Department of Energy, USA; Ali Mahdavi, M., Department of Energy, USA; May 31, 1998; 13p; In English; 13th; Plasma Surface Interactions, USA
Report No.(s): DE98-005671; ORNL/CP-98390; CONF-980560; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Pellet injection has been used on the D3-D tokamak to study density limits and particle transport in H-mode and inner wall limited L-mode plasmas. These experiments have provided a variety of conditions in which to examine the fueling efficiency of pellets injected into D3-D plasmas. The fueling efficiency defined as the total increase in number of plasma electrons divided by the number of pellet fuel atoms, is determined by measurements of density profiles before and just after pellet injection. The authors have found that there is a decrease in the pellet fueling efficiency with increased neutral beam injection power. The pellet penetration depth also decreases with increased neutral beam injection power so that, in general, fueling efficiency increases with penetration depth. The fueling efficiency is generally 25% lower in ELMing H-mode discharges than in L-mode due to an expulsion of particles with a pellet triggered ELM. A comparison with fueling efficiency data from other tokamaks shows similar behavior.
NTIS
Pellets; Tokamak Devices; Density (Number/Volume); Particle Energy; Beam Injection

19990028466 Department of Energy, Office of Energy Research, Washington, DC USA
Ion anomalous transport and feedback control ***Final Report, 1 Sep. 1987 - 31 Aug. 1997***
Sen, A. K., Department of Energy, USA; Jan. 31, 1998; 44p; In English
Report No.(s): DE98-004189; DOE/ER/53257-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This final report is comprised of the following six progress reports: Ion Temperature Gradient Instability and Anomalous Transport, July 1989; Ion Temperature Gradient Instability and Anomalous Transport, August 1991; Ion Temperature Gradient Instability and Anomalous Transport, July 1993; Ion Anomalous Transport and Feedback Control, May 1994; Ion Anomalous Transport and Feedback Control, April 1995; and Ion Anomalous Transport and Feedback Control, December 1997.
NTIS
Ion Temperature; Feedback Control; Anomalies

19990028471 Department of Energy, Office of Energy Research, Washington, DC USA
Divertor erosion in D3-D
Whyte, D. G., Department of Energy, USA; Bastasz, R., Department of Energy, USA; Wampler, W. R., Department of Energy, USA; Brooks, J. N., Department of Energy, USA; West, W. P., Department of Energy, USA; May 31, 1998; 25p; In English; 13th; Plasma Surface Interactions, USA
Report No.(s): DE98-005507; SAND-98-1238C; CONF-980560; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Net erosion rates of carbon target plates have been measured in situ for the DIII-D lower divertor. The principal method of obtaining this data is the DiMES sample probe. Recent experiments have focused on erosion at the outer strike-point of two divertor plasma conditions: (1) attached (Te > 40 eV) ELMing plasmas and (2) detached (Te < 2 eV) ELMing plasmas. The erosion rates for the attached cases are > 10 cm/year, even with incident heat flux < 1 MW/m(sup 2). In this case, measurements and modeling agree for both gross and net carbon erosion, showing the near-surface transport and redeposition of the carbon is well understood and that effective sputtering yields are > 10%. In ELM-free discharges, this erosion rate can account for the rate of carbon accumulation in the core plasma. Divertor plasma detachment eliminates physical sputtering, while spectroscopically measured chemical erosion yields are also

found to be low (Y(C/D(sup +)) (le) 2.0 (times) 10(sup (minus)3)). This leads to suppression of net erosion at the outer strike-point, which becomes a region of net redeposition ((approximately) 4 cm/year). The private flux wall is measured to be a region of net redeposition with dense, high neutral pressure, attached divertor plasmas. Leading edges intercepting parallel heat flux ((approximately) 50 MW/m(sup 2)) have very high net erosion rates ((approximately) 10 (micro)m/s) at the OSP of an attached plasma. Leading edge erosion, and subsequent carbon redeposition, caused by tile gaps can account for half of the deuterium codeposition in the DIII-D divertor.
NTIS
Carbon; Deposition; Erosion; Plasmas (Physics); Conferences; Heat Flux

19990028474 Department of Energy, Washington, DC USA
Structural effects in ICF foam-buffered targets
Mason, R. J., Department of Energy, USA; Kopp, R. A., Department of Energy, USA; Goldman, S. R., Department of Energy, USA; Wilson, D. C., Department of Energy, USA; Watt, R. G., Department of Energy, USA; Oct. 31, 1997; 8p; In English; 11th; Nuclear Explosive Design Explosive Physics, USA
Report No.(s): DE98-005280; LA-UR-98-187; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Experiments have indicated that low-density foam buffer layers can significantly mitigate the perturbing effects of beam non-uniformities in direct drive laser-matter interactions. A smooth drive is essential to obtaining ignition in the Direct Drive approach to ICF ignition. Consequently, the authors have conducted a detailed study of the mitigating capabilities of foam-buffers, and how to optimize then. Smoothly driven implosions may prove crucial to obtaining the high energy and neutron yields needed for Science Based Stockpile Stewardship applications.
NTIS
Electromagnetic Interactions; Foams; Stockpiling; Implosions; Conferences

19990028524 Department of Energy, Washington, DC USA
Classical Rayleigh-Taylor instability experiments at Nova
Budil, K. S., Department of Energy, USA; Remington, B. A., Department of Energy, USA; Weber, S. V., Department of Energy, USA; Perry, T. S., Department of Energy, USA; Peyser, T. A., Department of Energy, USA; Nov. 10, 1997; 43p; In English; Sponsored by American Physical Society, USA
Report No.(s): DE98-052172; UCRL-JC-128019; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The evolution of the Rayleigh-Taylor (RT) instability at an embedded, or classical, interface is examined in a series of experiments at the Nova laser facility .(reference for Nova) These experiments focused on the transition from the linear to nonlinear regimes for both single- and multimode initial perturbations. The development of a single mode at the embedded interface is compared to its evolution at an ablation front and the effect of ablative stabilization is experimentally demonstrated. The multimode experiments have shown evidence of the process of bubble competition, where in neighboring structures either continue to rise or are washed downstream in the flow depending upon their relative size. The experiments with simulations performed with either the LASNEX are compared code (G. B.Zimmerman and W. L. Kruer, Comments Plasma Phys. Controlled Fusion 2,51 (1975).), a two-dimensional Lagrangian radiation-hydrodynamics code, or CALE (R. Tipton, reference for CALE) , a two-dimensional arbitrary Lagrange-Eulerian radiation-hydrodynamics code.
NTIS
Experimentation; Taylor Instability; Plasmas (Physics); Perturbation; Lasers

19990028802 Department of Energy, Washington, DC USA
Preconceptual design requirements for the X-1 Advanced Radiation Source
Rochau, G. E., Department of Energy, USA; Hands, J. A., Department of Energy, USA; Raglin, P. S., Department of Energy, USA; Ramirez, J. J., Department of Energy, USA; Goldstein, S. A., Department of Energy, USA; Dec. 31, 1998; 6p; In English; 23rd; Power modulator, USA
Report No.(s): DE98-005920; SAND-98-0642C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The X-1 Advanced Radiation Source represents the next step in providing the US Department of Energy's Stockpile Stewardship Program with the high-energy, large volume, laboratory x-ray source for the Radiation Effects Science and Simulation, Inertial Confinement Fusion, and Weapon Physics Programs. Advances in fast pulsed power technology and in z-pinch hohlraums on Sandia National Laboratories' Z Accelerator provide sufficient basis for pursuing the development of X-1. The X-1 plan follows a strategy based on scaling the 2 MJ x- ray output on Z via a 3-fold increase in z-pinch load current. The large volume (>5 cm(exp 3)), high temperature (>150 eV), temporally long (>10 ns) hohlraums are unique outside of underground nuclear weapon testing. Analytical scaling arguments and hydrodynamic simulations indicate that these hohlraums

at temperatures of 230--300 eV will ignite thermonuclear fuel and drive the reaction to a yield of 200 to 1,000 MJ in the laboratory. X-1 will provide the high-fidelity experimental capability to certify the survivability and performance of non-nuclear weapon components in hostile radiation environments. Non-ignition sources will provide cold x-ray environments (<15 keV), and high yield fusion burn sources will provide high fidelity warm x-ray environments (15 keV--80 keV).
NTIS
Radiation Sources; X Ray Sources; Design Analysis

19990028806 Department of Energy, Washington, DC USA
Prospect for fusion energy with light ions
Mehlhorn, T. A., Department of Energy, USA; Adams, R. G., Department of Energy, USA; Bailey, J. E., Department of Energy, USA; Dec. 31, 1998; 6p; In English; 12th; High power particle beams, USA
Report No.(s): DE98-005909; SAND-98-1397C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Intense ion beams may be the best option for an Inertial Fusion Energy (IFE) driver. While light ions may be the long-term pulsed power approach to IFE, the current economic climate is such that there is no urgency in developing fusion energy sources. Research on light ion beams at Sandia will be suspended at the end of this fiscal year in favor of z-pinches studying ICF target physics, high yield fusion, and stewardship issues. The authors document the status of light ion research and the understanding of the feasibility of scaling light ions to IFE.
NTIS
Light Ions; Inertial Fusion (Reactor)

19990031836 Department of Energy, Office of Energy Research, Washington, DC USA
Scientific visualization of 3-dimensional optimized stellarator configurations
Spong, D. A., Department of Energy, USA; Jan. 31, 1998; 6p; In English; 16th; Numerical Simulation of Plasmas, USA
Report No.(s): DE98-004049; ORNL/CP-96406; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The design techniques and physics analysis of modern stellarator configurations for magnetic fusion research rely heavily on high performance computing and simulation. Stellarators, which are fundamentally 3-dimensional in nature, offer significantly more design flexibility than more symmetric devices such as the tokamak. by varying the outer boundary shape of the plasma, a variety of physics features, such as transport, stability, and heating efficiency can be optimized. Scientific visualization techniques are an important adjunct to this effort as they provide a necessary ergonomic link between the numerical results and the intuition of the human researcher. The authors have developed a variety of visualization techniques for stellarators which both facilitate the design optimization process and allow the physics simulations to be more readily understood.
NTIS
Stellarators; Scientific Visualization; Design Analysis

19990031872 Rutherford Appleton Lab., Chilton, UK
Third International Workshop on the Fast Ignition of Fusion Targets
Norreys, P. A., Rutherford Appleton Lab., UK; Jan. 08, 1999; ISSN 1358-6254; 356p; In English; 3rd; Fast Ignition of Fusion Targets, 21-23 Sep. 1998, Chilton, UK
Report No.(s): PB99-127516; RAL-TR-1998-085; Copyright Waived; Avail: CASI; A16, Hardcopy; A03, Microfiche

The 3rd International Workshop on Fast Ignition of Fusion Targets was held at the Rutherford Appleton Laboratory in the UK between 21-23rd September 1998. The proceeding demonstrates that tremendous progress is being made in both theory and experiment. In addition to new physical insights provided by two and three dimensional particles in cell simulations to describe relativistic laser plasma interactions, new hybrid codes have been developed to provide integrated descriptions of electron transport in solid density plasmas. A striking feature of the presentations was the necessity to integrate electron acceleration mechanisms arising in the coronal plasma, mechanisms which had previously been thought to be useful only to new accelerator concepts. Another new feature of this workshop was the inclusion of a session devoted to nuclear physics techniques to diagnose the plasma conditions, techniques which will undoubtedly grow in importance in future experimental work in the field.
NTIS
Conferences; Laser Plasma Interactions; Electron Transfer; Electron Acceleration; Plasmas (Physics)

19990031882 Department of Energy, Office of Energy Research, Washington, DC USA

Deposition of lithium on a plasma edge probe in TFTR -- Behavior of lithium-painted walls interacting with edge plasmas

Hirooka, Y., Department of Energy, USA; Ashida, K., Department of Energy, USA; Kugel, H., Department of Energy, USA; May 31, 1998; 18p; In English; 13th; Plasma surface interactions, USA

Report No.(s): DE98-005506; SAND-98-1236C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent observations have indicated that lithium pellet injection wall conditioning plays an important role in achieving the enhanced supershot regime in TFTR. However, little is understood about the behavior of lithium-coated limiter walls, interacting with edge plasmas. In the final campaign of TFTR, a cylindrical carbon fiber composite probe was inserted into the boundary plasma region and exposed to ohmically-heated deuterium discharges with lithium pellet injection. The ion-drift side probe surface exhibits a sign of codeposition of lithium, carbon, oxygen, and deuterium, whereas the electron side essentially indicates high-temperature erosion. It is found that lithium is incorporated in these codeposits in the form of oxide at the concentration of a few percent. In the electron side, lithium has been found to penetrate deeply into the probe material, presumably via rapid diffusion through interplane spaces in the graphite crystalline. Though it is not conclusive, materials mixing in the carbon and lithium system appears to be a key process in successful lithium wall conditioning.

NTIS

Deposition; Lithium; Plasma Probes; Tokamak Devices; Walls; Plasmas (Physics)

19990031886 Department of Energy, Washington, DC USA

Modeling a 1-D bremsstrahlung and neutron imaging array for use on Sandia's Z machine

Rochau, G. A., Department of Energy, USA; Derzon, M. S., Department of Energy, USA; Fehl, D., Department of Energy, USA; Rochau, G. E., Department of Energy, USA; Lazier, S., Department of Energy, USA; Jun. 30, 1998; 15p; In English; 12th; High-temperature plasma diagnostics, USA

Report No.(s): DE98-005529; SAND-98-0472C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Inertial confinement fusion (ICF) is being studied on the Z facility at Sandia National Laboratories. Z is a large z-pinch machine which can provide 20 MA of current to z-pinch loads producing approximately 1.8 MJ of soft x-rays in less than 10 ns. Within the pinch region, decelerated electrons produce a strong source of bremsstrahlung radiation which varies from shot to shot. Additionally, a variety of ICF targets produce fusion neutrons whose intensity and distribution depend on the temperature and density of the target compression in the pinch. This paper describes the computer modeling behind the shielding design of a simple time-resolved, 1-D imaging array which can provide a time history of both the bremsstrahlung and neutron production as a function of height within the target region. It is demonstrated that by building an array of scintillator fibers separated by long, thin tungsten collimator plates, a spatial resolution of 0.254 mm at the target can be achieved. The corresponding channel-to-channel discrimination for such a design is shown to be better than 1000::1 for less than 4 MeV photons and 100::1 for 2.45 MeV neutrons. by coupling scintillator fibers to a fiber-optic streak camera system, the signal can also be given as a function of time with a temporal resolution of about 1.2 ns.

NTIS

Bremsstrahlung; Neutrons; Imaging Techniques; Arrays; Zeta Pinch

19990031890 Department of Energy, Office of Energy Research, Washington, DC USA

Noble gas impurity balance and exhaust model for DIII-D and JET

Hillis, D. L., Department of Energy, USA; Hogan, J., Department of Energy, USA; Wade, M. R., Department of Energy, USA; Hellermann, M., Department of Energy, USA; Ehrenberg, J., Department of Energy, USA; May 31, 1998; 17p; In English; 13th; Plasma surface interactions, USA

Report No.(s): DE98-005577; ORNL/CP-98123; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Experiments to study the exhaust of noble gases (helium, neon) with cryopumping in DIII-D Advanced Divertor Program (ADP) configuration and in JET (Mk1 configuration) found significant differences in the global exhaust rate of helium, while efficient neon exhaust was observed in both machines. An attempt to better understand the basic processes governing the exhaust of noble gases in ELM H-mode with cryopumping has been undertaken. Since divertor geometries investigated in the DIII-D and in the JET cases have significant differences, a comparative modeling study has been undertaken using the MIST core impurity transport code and the b2.5 time-independent divertor transport code. Photodiode measurements are used to determine ELM frequency, and charge- exchange recombination (CER) measurements are compared with the MIST ELM model to evaluate transport coefficients in the core plasma. A significant reduction in the anomalous diffusivities is found for the non-ELM component of radial transport without the need for a pinch velocity, and the model provides a more coherent description than the conventional

ELM-averaged approach. Sensitivity to boundary conditions has been studied through establishment of a database of divertor enrichment cases using b2.5.
NTIS
Impurities; Exhaust Gases; Rare Gases

19990031898 Department of Energy, Washington, DC USA
Fast resistive bolometry
Spielman, R. B., Department of Energy, USA; Deeney, C., Department of Energy, USA; Fehl, D. L., Department of Energy, USA; Hanson, D. L., Department of Energy, USA; Keltner, N. R., Department of Energy, USA; Jun. 30, 1998; 20p; In English; 12th; High-temperature plasma diagnostics, USA
Report No.(s): DE98-005701; SAND-98-1310C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Resistive bolometry is an accurate, robust, spectrally broadband technique for measuring absolute x-ray fluence and flux. Bolometry is an independent technique for x-ray measurements that is based on a different set of physical properties than other diagnostics such as x-ray diodes, photoconducting detectors, and P-I-N diodes. Bolometers use the temperature-driven change in element resistivity to determine the total deposited energy. The calibration of such a device is based on fundamental material properties and its physical dimensions. The authors describe the use of nickel and gold bolometers to measure x rays generated by high power Z pinches on Sandia's Saturn and Z accelerators. The Sandia bolometer design described herein has a pulse response of approximately 1 ns. They describe in detail the fabrication, fielding, and data analysis issues leading to highly accurate x-ray measurements. The fundamental accuracy of resistive bolometry is discussed.
NTIS
Bolometers; Electrical Resistivity

19990031899 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Fusion with Z-pinches
Cook, D., Department of Energy, USA; Jun. 30, 1998; 8p; In English; 9th; Emerging nuclear energy systems (ICENES 1998), 1998, USA
Report No.(s): DE98-005703; SAND-98-1307C; CONF-980659; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the past thirty-six months, great progress has been made in x-ray production using high-current z-pinches. Today, the x-ray energy and power output of the Z accelerator (formerly PBFA-II) is the largest available in the laboratory. These z-pinch x-ray sources have the potential to drive high-yield Inertial Confinement Fusion (ICF) reactions at affordable cost if several challenging technical problems can be overcome. In this paper, the recent technical progress with Z-pinches are described, and a technical strategy for achieving high-yield ICF with z- pinches are presented.
NTIS
Zeta Pinch; Technology Assessment; Inertial Fusion (Reactor)

19990031954 Department of Energy, Washington, DC USA
Filtered x-ray diode diagnostics fielded on the Z-accelerator for source power measurements
Chandler, G. A., Department of Energy, USA; Deeney, C., Department of Energy, USA; Cuneo, M., Department of Energy, USA; Jun. 02, 1998; 21p; In English; 12th; High temperature plasma diagnostics, USA
Report No.(s): DE98-005528; SAND-98-0394C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Filtered x-ray diode, (XRD), detectors are used as primary radiation flux diagnostics on Sandia's Z-accelerator, which generates nominally a 200 TW, 2 MJ, x-ray pulse. Given such flux levels and XRD sensitivities the detectors are being fielded 23 meters from the source. The standard diagnostic setup and sensitivities are discussed. Vitreous carbon photocathodes are being used to reduce the effect of hydrocarbon contamination present in the Z-machine vacuum system. Nevertheless pre- and post-calibration data taken indicate spectrally dependent changes in the sensitivity of these detectors by up to factors up to 2 or 3.
NTIS
Diagnosis; X Rays; Diodes; Plasma Diagnostics; Radiation Detectors; Accelerators

19990031955 Department of Energy, Washington, DC USA
Axial diagnostic package for Z
Nash, T. J., Department of Energy, USA; Derzon, M. S., Department of Energy, USA; Chandler, G., Department of Energy, USA; Jun. 30, 1998; 16p; In English; 12th; High temperature plasma diagnostics, USA
Report No.(s): DE98-005523; SAND-97-3167C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have developed and fielded an axial diagnostic package for the 20 MA, 100 ns, z-pinch driver Z. The package is used to diagnose dynamic hohlraum experiments which require an axial line of sight. The heart of the package is a reentrant cone originally used to diagnose ion-beam-driven hohlraums on PBFA-H. It has one diagnostic line of sight at 0 deg, 4 at 6 deg, and 4 at 9 deg. In addition it has a number of viewing, alignment, and vacuum feedthrough ports. The front of the package sits approximately 5 feet from the pinch. This allows much closer proximity to the pinch, with inherently better resolution and signal, than is presently possible in viewing the pinch from the side. Debris that is preferentially directed along the axis is mitigated by two apertures for each line of sight, and by fast valves and imaging pinholes or cross slits for each diagnostic. In the initial run with this package they fielded a time resolved pinhole camera, a five-channel pinhole-apertured x-ray diode array, a bolometer, a spatially resolved time- integrated crystal spectrometer, and a spatially and temporally resolved crystal spectrometer. They present data obtained from these diagnostics in the dynamic hohlraum research conducted on Z.
NTIS
Zeta Pinch; Diagnosis; Plasma Diagnostics

19990031957 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
X-1: The challenge of high fusion yield
Cook, D. L., Department of Energy, USA; Ramirez, J. J., Department of Energy, USA; Raglin, P. S., Department of Energy, USA; Jun. 30, 1998; 6p; In English; 12th; High power particle beams, USA
Report No.(s): DE98-005519; SAND-98-1292C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In the past three years, tremendous strides have been made in x-ray production using high-current z-pinches. Today, the x-ray energy and power output of the Z accelerator (formerly PBFA II) is the largest available in the laboratory. These z-pinch x-ray sources have great potential to drive high-yield inertial confinement fusion (ICF) reactions at affordable cost if several challenging technical problems can be overcome. Technical challenges in three key areas are discussed in this paper: (1) the design of a target for high yield, (2) the development of a suitable pulsed power driver, and (3) the design of a target chamber capable of containing the high fusion yield.
NTIS
High Current; Zeta Pinch; X Ray Sources

19990031958 Department of Energy, Washington, DC USA
Intense beams: The past, present, and future
Yonas, G., Department of Energy, USA; Sweeney, M. A., Department of Energy, USA; Jun. 30, 1998; 8p; In English; 12th; High power particle beams, USA
Report No.(s): DE98-005518; SAND-98-1286C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Pulsed power research began in the early 1960s with the development of the technology to test the reliability of nuclear weapons in a pulsed radiation environment. Because of the effort in the 1970s on an electron beam approach to inertial confinement fusion (ICF) at Sandia National Laboratories and at the Kurchatov Institute, simulation codes, diagnostics, and innovative pulsed power techniques such as self-magnetic insulation were developed. The electron approach ended in 1979, and the more promising ion approach continued. At the same time, z pinches, used since the early 1970s to evaluate the response of materials to keV X rays, were considered as an alternative to drive ICF capsules. The use of z pinches for ICF was discontinued in 1984 because of budget cuts and the belief that ions offered a route to the standoff requirement for energy applications. Now, in 1998, because of budget limitations and the 1995 discovery that the soft x-ray power achievable in a z-pinch implosion can be greatly enhanced, the ion approach has been suspended, and a new facility, X-1, proposed to achieve high yield in the laboratory with z pinches. In this paper the authors review the research paths that led to these changes, describe the present status of z pinches, and predict what the future holds. The paper concludes with some of these lessons learned.
NTIS
Electron Beams; Zeta Pinch; Ion Beams

19990032031 Department of Energy, Washington, DC USA
Design process for NIF laser alignment and beam diagnostics
Grey, A., Department of Energy, USA; Jun. 09, 1998; 20p; In English
Report No.(s): DE98-058852; UCRL-ID-129855; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In a controller for an adaptive optic system designed to correct phase aberrations in a high power laser, the wavefront sensor is a discrete Hartmann-Shack design. It uses an army of lenslets (like a fly's eye) to focus the laser into 77 spots on a CCD camera. Average local tilt of the wavefront across each lenslet changes the position of its focal spot. The system requires 0.1 pixel accuracy in determining the focal spot location. We determine a small area around each spot's previous location. Within this area, we calcu-

late the centroid of the light intensity in x and y. This calculation fails if the spot regions overlap. Especially during initial acquisition of a highly distorted beam, distinguishing overlapping spots is difficult. However, low resolution analysis of the overlapping spots allows the system to estimate their positions. With this estimate, it can use the deformable mirror to correct the beam enough so we can detect the spots using conventional image processing.
NTIS
Laser Beams; Alignment; Design Analysis; Diagnosis

19990032093 Department of Energy, Washington, DC USA
Fast Ignitor coupling physics
Mason, R. J., Department of Energy, USA; Tabak, M., Department of Energy, USA; Oct. 31, 1997; 9p; In English; 11th; Nuclear explosive design explosive physics, USA
Report No.(s): DE98-005281; LA-UR-98-188; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Fast Ignitor is an alternate approach to ICF in which short pulse lasers are used to initiate burn at the surface of the compressed DT fuel. The aim is to avoid the need for careful central focusing of final shocks, and possibly to lower substantially the energy requirements for ignition. Ultimately, both goals may prove crucial to Science Based Stockpile Stewardship (SBSS). This will be the case should either emerging energetic needs, or finding difficulties render the presently planned radiative fusion approach to ignition with the NIF impractical. Ignition is a first step towards the achievement of substantial energy and neutron outputs for such Stewardship.
NTIS
Ignition; Energy Requirements; Coupling

19990032113 Department of Energy, Office of Energy Research, Washington, DC USA
Review of the US joining technologies for plasma facing components in the ITER fusion reactor
Odegard, B. C., Department of Energy, USA; Cadden, C. H., Department of Energy, USA; Watson, R. D., Department of Energy, USA; Slattery, K. T., Department of Energy, USA; Feb. 28, 1998; 17p; In English; 8th; Fusion Reactor Materials (ICFRM), USA
Report No.(s): DE98-052587; SAND-97-8635; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper is a review of the current joining technologies for plasma facing components in the US for the International Thermonuclear Experimental Reactor (ITER) project. Many facilities are involved in this project. Many unique and innovative joining techniques are being considered in the quest to join two candidate armor plate materials (beryllium and tungsten) to a copper base alloy heat sink (CuNiBe, OD copper, CuCrZr). These techniques include brazing and diffusion bonding, compliant layers at the bond interface, and the use of diffusion barrier coatings and diffusion enhancing coatings at the bond interfaces. The development and status of these joining techniques will be detailed in this report.
NTIS
Thermonuclear Reactions; Fusion Reactors; Diffusion Welding; Plasmas (Physics); Tokamak Devices

19990032131 Department of Energy, Washington, DC USA
Development of a cryogenic EOS capability for the Z Pulsed Radiation Source: Goals and accomplishments of FY97 LDRD project
Hanson, D. L., Department of Energy, USA; Johnston, R. R., Department of Energy, USA; Asay, J. R., Department of Energy, USA; Mar. 31, 1998; 36p; In English
Report No.(s): DE98-004416; SAND-98-0564; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Experimental cryogenic capabilities are essential for the study of ICF high- gain target and weapons effects issues involving dynamic materials response at low temperatures. The goal of this project is the development of a general purpose cryogenic target system for precision EOS and shock physics measurements at liquid helium temperatures on the Z accelerator Z-pinch pulsed radiation source. Activity during the FY97 LDRD phase of this project has focused on development of a conceptual design for the cryogenic target system based on consideration of physics, operational, and safety issues, design and fabrication of principal system components, construction and instrumentation of a cryogenic test facility for off-line thermal and optical testing at liquid helium temperatures, initial thermal testing of a cryogenic target assembly, and the design of a cryogenic system interface to the Z pulsed radiation source facility. The authors discuss these accomplishments as well as elements of the project that require further work.
NTIS
Cryogenics; Radiation Sources; Fabrication; Construction; Mechanical Properties; Dynamic Response

19990032196 Department of Energy, Office of Energy Research, Washington, DC USA

Investigation of structure, chemical composition, hydrogen isotope trapping and release processes in deposition layers on surfaces exposed to DIII-D divertor plasma

Buzhinskij, O. I., Department of Energy, USA; Opimach, I. V., Department of Energy, USA; Barsuk, V. A., Department of Energy, USA; Arkhipov, I. I., Department of Energy, USA; West, W. P., Department of Energy, USA; May 31, 1998; 6p; In English; 13th; Plasma surface interactions, USA

Report No.(s): DE98-005503; SAND-98-1293C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The exposure of ATG graphite sample to DIII-D divertor plasma was provided by the DiMES (Divertor Material Evaluation System) mechanism. The graphite sample arranged to receive the parallel heat flux on a small region of the surface was exposed to 600 ms of outer strike point plasma. The sample was constructed to collect the eroded material directed downward into a trapping zone onto s Si disk collector. The average heat flux onto the graphite sample during the exposure was about 200 W/sq cm, and the parallel heat flux was about 10 KW/sq cm. After the exposure the graphite sample and Si collector disk were analyzed using SEM, NRA, RBS, Auger spectroscopy. IR and Raman spectroscopy. The thermal desorption was studied also. The deposited coating on graphite sample is amorphous carbon layer. Just upstream of the high heat flux zone the redeposition layer has a globular structure. The deposition layer on Si disk is composed also from carbon but has a diamond-like structure. The areal density of C and D in the deposited layer on Si disk varied in poloidal and toroidal directions. The maximum D/C areal density ratio is about 0.23, maximum carbon density is about 3.8 x 10(exp 18)cm(exp -2), maximum D area density is about 3 x 10(exp 17) sq cm. The thermal desorption spectrum had a peak at 1,250 K.

NTIS

Chemical Composition; Hydrogen Isotopes; Trapping; Tokamak Devices; Plasmas (Physics); Graphite; Crystal Structure; Divertors (Fusion Reactors)

19990032197 Department of Energy, Office of Energy Research, Washington, DC USA

Electron cyclotron discharge cleaning (ECDC) experiments on Alcator C-Mod

Nachtrieb, R. T., Department of Energy, USA; LaBombard, B. L., Department of Energy, USA; Terry, J. L., Department of Energy, USA; Reardon, J. C., Department of Energy, USA; Rowan, W. L., Department of Energy, USA; May 31, 1998; 11p; In English; 13th; Plasma surface interactions, USA

Report No.(s): DE98-005504; SAND-98-1237C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Experiments were performed on Alcator C-Mod with Electron Cyclotron resonance plasmas to help determine their applicability to a fusion reactor. Strong radial inhomogeneity of the plasma density was measured, decreasing by a factor of ten a few centimeters inside the resonance location, but remaining approximately constant (n(sub e)) approximately 10(exp 16) m(exp -3) outside the resonance location. Electron and ion temperatures remained mostly constant outside the resonance location (Tau)(sub e) approximately 10 eV, (Tau)(sub i) approximately 2e V. Toroidal asymmetries in ion saturation current density were observed, indicating local toroidal plasma flow. The ECR plasma was used to remove a diamond-like carbon coating from a stainless-steel sample. Removal rates peaked at 4.2 +/- 0.4 nm/hour with the sample a few centimeters outside the resonance location. Removal rates decreased inside and further outside the resonance location. The plasma did not remove the carbon from the sample uniformly, possibly due to plasma flow. Yields were calculated (Y approximately 10(exp -3)) to be lower than other published results for chemical sputtering of deuterium ions on carbon, possibly due to toroidally asymmetric plasma conditions. Significant redeposition was not observed.

NTIS

Electron Cyclotron Resonance; Fusion Reactors; Cleaning

19990032198 Department of Energy, Office of Energy Research, Washington, DC USA

Molybdenum erosion measurements in Alcator C-Mod

Wampler, W. R., Department of Energy, USA; LaBombard, B., Department of Energy, USA; Lipshultz, B., Department of Energy, USA; Pappas, D., Department of Energy, USA; Pitcher, C. S., Department of Energy, USA; May 31, 1998; 14p; In English; 13th; Plasma surface interactions, USA

Report No.(s): DE98-005505; SAND-97-2736C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Erosion of molybdenum was measured on a set of 21 tiles after a run campaign of 1,090 shots in the Alcator C-Mod tokamak. The net erosion of molybdenum, was determined from changes in the depth of a thin chromium marker layer measured by Rutherford backscattering. Net Mo erosion was found to be approximately 150 nm near the outer divertor strike point, and much less everywhere else. Gross erosion rates by sputtering were estimated using ion energies and fluxes obtained from Langmuir probe

measurements of edge-plasma conditions. Predicted net erosion using calculated gross erosion with prompt redeposition and measured net erosion agree within a factor of 3. Sputtering by boron and molybdenum impurities dominates erosion.
NTIS
Molybdenum; Erosion

19990032246 Department of Energy, Washington, DC USA
Cryogenic capability for equation-of-state measurements on the Sandia Z pulsed radiation source
Hanson, D. L., Department of Energy, USA; Johnston, R. R., Department of Energy, USA; Asay, J. R., Department of Energy, USA; Feb. 28, 1998; 16p; In English; 37th; JOWOG, USA
Report No.(s): DE98-005463; SAND-98-0290C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Experimental cryogenic capabilities are essential for the study of ICF high-gain target and weapons effects issues involving dynamic materials response at low temperatures. The authors are developing a general purpose cryogenic target system for precision radiation driven EOS and shock physics experiments at liquid helium temperatures on the Sandia Z pulsed radiation source. Cryogenic sample cooling in the range of 6--30 K is provided by a liquid helium cryostat and an active temperature control system. The cryogenic target assembly is capable of condensing liquid deuterium samples from the gas phase at about 20 K, as well as cooling solid samples such as beryllium and CH ablators for ICF. The target assembly will also include the capability to use various shock diagnostics, such as VISAR interferometry and fiber-optic-coupled shock breakout diagnostics. They are characterizing the thermal and optical performance of the system components in an off-line cryogenic test facility and have designed an interface to introduce the cryogenic transfer lines, gas lines, and sensor cables into the Z vacuum section. Survivability of high-value cryogenic components in the destructive post-implosion environment of Z is a major issue driving the design of this cryogenic target system.
NTIS
Cryogenics; Equations of State; Pulsed Radiation

19990032247 Department of Energy, Washington, DC USA
Absolute, soft x-ray calorimetry on the Z facility at Sandia National Laboratories
Fehl, D. L., Department of Energy, USA; Muron, D. J., Department of Energy, USA; Leeper, R. J., Department of Energy, USA; Chandler, G. A., Department of Energy, USA; Deeney, C., Department of Energy, USA; May 31, 1998; 23p; In English; 12th; High-temperature plasma diagnostics, USA
Report No.(s): DE98-005460; SAND-98-0555C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Simple and reliable x-ray fluence measurements, in addition to time- resolved diagnostics, are needed to understand the physics of hot Z-pinch plasmas. A commercially available laser calorimeter has been modified for measuring soft x-ray fluence from the Z facility at Sandia National Laboratories. The x-ray absorber of this calorimeter is an aluminum disk, attached to a two-dimensional thermopile and surrounded by an isoperibol shroud. The time-integral and the maximum of the thermopile voltage signal are both proportional to the x-ray energy deposited. Data are collected for 90 seconds, and the instrument has, thus far, been used in the 1--25 mJ range. A wider dynamic measuring range for x-ray fluence (energy/area) can be achieved by varying the area of the defining aperture. The calorimeter is calibrated by an electrical substitution method. Calibrations are performed before and after each x-ray experiment on the Z facility. The calibration of the time-integral of the thermopile voltage vs. energy deposited (or the peak of thermopile voltage vs. energy deposited) is linear with zero offset at the 95% confidence level. The irreproducibility of the calibration is <2%, and the imprecision in the measurement of the incident x-ray energy (inferred from signal noise and the calibration) is estimated to be approximately 0.9 mJ (95% confidence level) . The inaccuracy is estimated at +/- 10%, due to correctable systematic errors (e.g., baseline shifts). Comparisons have been made of the calorimeter to time- resolved x-ray diagnostics, e.g., bolometers and XRD (x-ray diode) arrays, by integrating the flux measured by these instruments over time.
NTIS
X Rays; Calorimeters; Zeta Pinch; X Ray Sources

19990032391 Department of Energy, Office of Energy Research, Washington, DC USA
Calibration issues for neutron diagnostics
Sadler, G. J., Department of Energy, USA; Adams, J. M., Department of Energy, USA; Barnes, C. W., Department of Energy, USA; Oct. 31, 1997; 14p; In English; Diagnostics for Experimental Fusion Reactors, USA
Report No.(s): DE98-002667; LA-UR-97-4066; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In order for ITER to meet its operational and programmatic goals, it will be necessary to measure a wide range of plasma parameters. Some of the required parameters e.g., neutron yield, fusion power and power density, ion temperature profile in the core plasma, and characteristics of confined and escaping alpha particle populations are best measured by fusion product diagnos-

tic techniques. To make these measurements, ITER will have dedicated diagnostic systems, including radial and vertical neutron cameras, neutron and gamma ray spectrometers, internal and external fission chambers, a neutron activation system, and diagnostics for confined and escaping alpha particles. Engineering integration of many of these systems is in progress, and other systems are under investigation. This paper summarizes the present state of design of fusion product diagnostic systems for ITER and discusses expected measurement capability.
NTIS
Calibrating; Neutrons; Plasma Diagnostics

19990032415 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
GaN etching in BCl3Cl2 plasmas
Shul, R. J., Department of Energy, USA; Ashby, C. I. H., Department of Energy, USA; Willison, C. G., Department of Energy, USA; Zhang, L., Department of Energy, USA; Han, J., Department of Energy, USA; Apr. 30, 1998; 9p; In English, USA; Sponsored by Materials Research Society, USA
Report No.(s): DE98-005455; SAND-98-1131C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

GaN etching can be affected by a wide variety of parameters including plasma chemistry and plasma density. Chlorine-based plasmas have been the most widely used plasma chemistries to etch GaN due to the high volatility of the GaCl3 and NCl etch products. The source of Cl and the addition of secondary gases can dramatically influence the etch characteristics primarily due to their effect on the concentration of reactive Cl generated in the plasma. In addition, high-density plasma etch systems have yielded high quality etching of GaN due to plasma densities which are 2 to 4 orders of magnitude higher than reactive ion etch (RIE) plasma systems. The high plasma densities enhance the bond breaking efficiency of the GaN, the formation of volatile etch products, and the sputter desorption of the etch products from the surface. In this study, the authors report GaN etch results for a high-density inductively coupled plasma (ICP) as a function of BCl3:Cl2 flow ratio, dc-bias, chamber-pressure, and ICP source power. GaN etch rates ranging from approximately 100 (angstrom)/min to > 8,000 (angstrom)/min were obtained with smooth etch morphology and anisotropic profiles.
NTIS
Gallium Nitrides; Boron Chlorides; Chlorine; Plasmas (Physics); Plasma Chemistry; Plasma Etching

19990032424 Department of Energy, Office of Energy Research, Washington, DC USA
Physics of advanced tokamaks
Taylor, T. S., Department of Energy, USA; Nov. 30, 1997; 19p; In English; 24th; Controlled Fusion and Plasma Physics, USA
Report No.(s): DE98-003429; GA-A22704; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Significant reductions in the size and cost of a fusion power plant core can be realized if simultaneous improvements in the energy replacement time, (tau)(sub E), and the plasma pressure or beta, (beta)(sub T) = 2 (micro)(sub 0) < P>/B(sup 2) can be achieved in steady-state conditions with high self-driven, bootstrap current fraction. Significant recent progress has been made in experimentally achieving these high performance regimes and in developing a theoretical understanding of the underlying physics. Three operational scenarios have demonstrated potential for steady state high performance, the radiative improved (RI) mode, the high internal inductance or high (ell)(sub i) scenario, and the negative central magnetic shear, NCS (or reversed shear, RS) scenario. In a large number of tokamaks, reduced ion thermal transport to near neoclassical values, and reduced particle transport have been observed in the region of negative or very low magnetic shear: the transport reduction is consistent with stabilization of microturbulence by sheared E x B flow. There is strong temporal and spatial correlation between the increased sheared E x B flow, the reduction in the measured turbulence, and the reduction in transport. The DIII-D tokamak, the JET tokamak and the JT-60U tokamak have all observed significant increases in plasma performance in the NCS operational regime. Strong plasma shaping and broad pressure profiles, provided by the H-mode edge, allow high beta operation, consistent with theoretical predictions; and normalized beta values up to (beta)(sub T)/(I/aB) (equivalent-to) (beta)(sub N) (approximately) 4.5%-m-T/MA simultaneously with confinement enhancement over L- mode scaling, H = (tau)/(tau)(sub ITER-89P) (approximately) 4, have been achieved in the DIII-D tokamak. In the JT-60U tokamak, deuterium discharges with negative central magnetic shear, NCS, have reached equivalent break-even conditions, Q(sub DT) (equiv) = 1.
NTIS
Tokamak Devices; Fusion Reactors; Thermonuclear Reactions

19990032528 Department of Energy, Washington, DC USA

National Ignition Facility for Inertial Confinement Fusion

Paisner, J. A., Department of Energy, USA; Murray, J. R., Department of Energy, USA; Oct. 08, 1997; 9p; In English; 17th; Fusion engineering, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-052044; UCRL-JC-128689; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The National Ignition Facility for inertial confinement fusion will contain a 1.8 MJ, 500 TW frequency-tripled neodymium glass laser system that will be used to explore fusion ignition and other problems in the physics of high temperature and density. We describe the facility briefly. The NIF is scheduled to be completed in 2003.

NTIS

Inertial Confinement Fusion; Ignition

19990032538 Department of Energy, Washington, DC USA

Hot electron production and heating by hot electrons in fast ignitor research

Key, M. H., Department of Energy, USA; Estabrook, K., Department of Energy, USA; Hammel, B., Department of Energy, USA; Dec. 01, 1997; 24p; In English; 39th, USA; Sponsored by American Physical Society, USA

Report No.(s): DE98-052118; UCRL-JC-129251; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In an experimental study of the physics of fast ignition the characteristics of the hot electron source at laser intensities up to 10(exp 20) Wcm(exp -2) and the heating produced at depth by hot electrons have been measured. Efficient generation of hot electrons but less than the anticipated heating have been observed.

NTIS

Ignition; Hot Electrons; Plasma Heating

19990032540 Department of Energy, Washington, DC USA

Science of NIF scale capsule development (activities for FY97)

Hamilton, K. E., Department of Energy, USA; Buckley, S. R., Department of Energy, USA; Cook, R. R., Department of Energy, USA; Nov. 12, 1997; 91p; In English

Report No.(s): DE98-052162; UCRL-ID-129331; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The focus of this work is the production of 2 mm P(alpha)MS mandrels by microencapsulation for use as National Ignition Facility (NIF) laser targets. It is our findings thus far that the processing techniques used previously for the 0.5 mm and 1.0 mm targets are no longer useful for preparation of the larger targets for a few fundamental reasons. The driving force for sphericity (from the minimization of interracial energy) decreases as the radius of curvature increases. Simultaneously, the mechanical robustness /stability of the water-oil-water emulsion droplets decreases as the droplet size increases. The impact of these physical conditions and the possibilities of circumventing these limitations have been examined while attempting to meet the NIF shell power spectrum criteria. Identifying the key parameters in the transition (solidification) from a w-o-w droplet to a solid polymer shell has been understood implicitly to be the paramount goal. It is believed through the knowledge gained that it will be possible to minimize the deleterious forces and maximize shell sphericity. At this point it is believed that properties intrinsic to the polymer (i.e., P(alpha)MS) such as its solution behavior and evolution of film stresses control the overall shell sphericity.

NTIS

Laser Targets; Encapsulating

19990032544 Department of Energy, Washington, DC USA

Performance of smoothing by spectral dispersion (SSD) with frequency conversion on the Beamlet Laser for the National Ignition Facility

Rothenberg, J. E., Department of Energy, USA; Morgan, B., Department of Energy, USA; Wegner, P., Department of Energy, USA; Weiland, T. W., Department of Energy, USA; Nov. 04, 1997; 11p; In English; Lasers and electro-optics, USA

Report No.(s): DE98-052170; UCRL-JC-128870; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Simulations and ongoing measurements indicate that SSD results in small degradation to the near field beam quality. The measured effect of SSD bandwidth on conversion to the third harmonic and smoothing of the target illumination will also be described.

NTIS

Smoothing; Spectra; Lasers; Frequency Converters

19990032549 Department of Energy, Washington, DC USA

Recent advances and challenges for diode-pumped solid-state lasers as an inertial fusion energy driver candidate

Payne, S. A., Department of Energy, USA; Beach, R. J., Department of Energy, USA; Bibeau, C., Department of Energy, USA; Dec. 23, 1997; 8p; In English; 17th; Fusion engineering, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-052203; UCRL-JC-129302; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We discuss how solid-state laser technology can serve in the interests of fusion energy beyond the goals of the National Ignition Facility (NIF), which is now being constructed to ignite a deuterium-tritium target to fusion conditions in the laboratory for the first time. We think that advanced solid- state laser technology can offer the repetition-rate and efficiency needed to drive a fusion power plant, in contrast to the single-shot character of NIF. We propose that a gas-cooled, diode-pumped Yb:S-FAP laser can provide a new paradigm for fusion laser technology leading into the next century.

NTIS

Diodes; Solid State Lasers; Laser Fusion; Laser Pumping

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SOLID-STATE PHYSICS

Includes superconductivity. For related information, see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

19990028319 Department of Energy, Office of Energy Research, Washington, DC USA

Study of the effects of MeV Ag and Au implantation on the optical properties of LiNbO3

Williams, E. K., Department of Energy, USA; Ila, D., Department of Energy, USA; Sarkisov, S., Department of Energy, USA; Curley, M., Department of Energy, USA; Cochrane, J. C., Department of Energy, USA; Oct. 31, 1997; 16p; In English; 9th; Radiation Effects in Insulators (REI-9), USA

Report No.(s): DE98-000689; ORNL/CP-94845; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present the results of characterization of linear absorption and nonlinear refractive index of Au and Ag nanoclusters made by MeV ion implantation into LiNbO3. Ag was implanted at 1.5 MeV to fluences of 2 to 17 x 10 to the 16th power/sq cm at room temperature. Au was implanted to fluences of 5 to 20 x 10 to the 16th power/sq cm at an energy of 2.0 MeV. Optical absorption spectrometry indicated an absorption peak at 560 nm for the Au implanted samples after a 30 minute heat treatment at 500 C in air. The peak shifted to approximately 620 nm after heat treatment at 1,000 C. The Ag implanted samples had absorption peaks at 445 to 485 nm before heat treatment. After 500 C heat treatment for 1 h, the peaks decreased in height and shifted to 545--560 nm. Heat treatment at 800 C was sufficient to return the Ag implanted crystals to a clear state. The size of the clusters was determined from the absorption peaks. The Ag clusters did not change appreciably in size with heat treatment. The Au clusters increased from 1 to 3 nm upon heat treatment at 1,000 C. Measurements of the nonlinear refractive indices were carried out using the Z-scan method with a tunable dye laser pumped by a frequency doubled mode locked Nd:YAG laser. The dye laser had a 4.5 ps pulse duration time and 76 MHz pulse repetition rate (575 nm).

NTIS

Ion Implantation; Optical Properties; Lithium Compounds; Niobates; Research; Refractivity; YAG Lasers; Absorption Spectra

19990028353 Department of Energy, Office of Energy Research, Washington, DC USA

Study of substrate diffusion in epitaxial n-type CdSe films grown on GaAs (001) by pulsed laser ablation

Park, J., Department of Energy, USA; Rouleau, C. M., Department of Energy, USA; Lowndes, D. H., Department of Energy, USA; Apr. 30, 1998; 9p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-004888; ORNL/CP-97498; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

N-type CdSe films with thicknesses of 470--630 nm were grown on (001) and 2(degree) - miscut GaAs wafers by ArF (193 nm) pulsed laser ablation of stoichiometric CdSe targets at platen temperatures (T(sub p)) of 250--425 C in vacuum and ambient Ar gas. Film-substrate interdiffusion was studied with Auger depth profiling, as well as energy dispersive x-ray fluorescent spectroscopy (EDS). Both techniques showed that extensive interdiffusion took place at the film-substrate interface for CdSe films grown at T(sub p) (ge) 355 C but was greatly reduced at T(sub p) = 250 C. Tilting the substrate to be approximately parallel to the ablation plume as well as decreasing the ambient gas pressure also reduced film-substrate interdiffusion.

NTIS

Research; Substrates; Diffusion; Epitaxy; N-Type Semiconductors; Cadmium Selenides; Crystal Growth; Gallium Arsenides

19990028355 Department of Energy, Office of Energy Research, Washington, DC USA

Structure, composition, and strain profiling of Si/SiO2 interfaces

Duscher, G., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Gao, H. J., Department of Energy, USA; Browning, N. D., Department of Energy, USA; Singh, R., Department of Energy, USA; Mar. 31, 1998; 8p; In English; Characterization and Metrology for ULSI Technology, 1998, USA

Report No.(s): DE98-004883; ORNL/CP-97259; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recently, the scanning transmission electron microscope has become capable of forming electron probes of atomic dimensions. This makes possible the technique of Z-contrast imaging, a method of forming incoherent images at atomic resolution having high compositional sensitivity. An incoherent image of this nature also allows the positions of atomic columns in a crystal to be directly determined, without the need for model structures and image simulations. Furthermore, atomic resolution chemical analysis can be performed by locating the probe over particular columns or planes seen in the image while electron energy loss spectra are collected. The authors present images of the Si/SiO2 interface showing no crystalline oxide, compositional profiles across a nitrided sample at 2.5 angstrom resolution showing an extended sub-stoichiometric zone, and strain profiles at a rough interface showing static rms displacements approximately 0.1 angstrom extending 10 angstroms into the crystalline Si.

NTIS

Crystal Structure; Silicon; Silicon Oxides; Interfaces; Chemical Composition; Energy Spectra; Energy Dissipation; Displacement; Chemical Analysis

19990028374 Department of Energy, Office of Energy Research, Washington, DC USA

Z-contrast imaging of ordered structures in Pb(Mg(sub 1/3)Nb(sub 2/3)) O3 and Ba(Mg(sub 1/3)Nb(sub 2/3))O3

Yan, Y., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Xu, Z., Department of Energy, USA; Viehland, D., Department of Energy, USA; Feb. 28, 1998; 5p; In English; Microscopy and Microanalysis 1998, 1998, USA

Report No.(s): DE98-005589; ORNL/CP-96681; CONF-980713; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Lead-based cubic perovskites such as Pb(B(sub 1/3)(sup 2+)B(sub 2/3)(sup 5+))O3 (B(sup 2+) = Mg, Co, Ni, Zn; B(sup 5+) = Nb, Ta) are relaxor ferroelectrics. Localized order and disorder often occur in materials of this type. In the Pb(Mg(sub 1/3)Nb(sub 2/3))O3 (PMN) family, previous studies have proposed two models, space-charge and charge-balance models. In the first model, the ordered regions carry a net negative charge (Pb(Mg(sub 1/2)Nb(sub 1/2))O3), while in the second model it does not carry a net charge (Pb((Mg(sub 2/3)Nb(sub 1/3))(sub 1/2)Nb(sub 1/2))O3). However, no direct evidence for these two models has appeared in the literature yet. In this paper the authors report the first direct observations of local ordering in undoped and La-doped Pb(Mg(sub 1/3)Nb(sub 2/3))O3, using high-resolution Z- contrast imaging. Because the ordered structure in Ba(Mg(sub 1/3)Nb(sub 2/3)) O3 is well known, the Z-contrast image from an ordered domain is used as a reference for this study.

NTIS

Crystal Structure; Lead Oxides; Perovskites; Imaging Techniques; Doped Crystals

19990028380 Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA

Effects of localized holes on charge transport, local structure and spin dynamics in the metallic state of CMR La(1-x)Ca(x)MnO3

Heffner, R. H., Department of Energy, USA; Hundley, M. F., Department of Energy, USA; Booth, C. H., Department of Energy, USA; Mar. 31, 1998; 15p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-004371; LA-UR-97-4864; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors review resistivity, x-ray absorption fine-structure (XAFS) and muon spin relaxation ((mu)SR) data which provide clear evidence for localized holes causing polaron distortion and unusual spin dynamics below (Tc) in 'colossal magnetoresistive' (CMR) La(1-x)Ca(x)MnO3. Resistivity measurements for x = 0.33 under an applied field H have shown that ln((rho)(H,T)) (infinity)-M, where M is the magnetization. The XAFS data show a similar functional dependence for the polaron distortions on M The data from these two measurements are interpreted in terms of some fraction of the available holes x remaining localized and some increasing fraction becoming delocalized with increasing M Finally, this polaron-induced spatial inhomogeneity yields anomalously slow, spatially inhomogeneous spin dynamics below (Tc), as shown in the (mu)SR data. These experiments individually probe the charge, lattice and spin degrees of freedom in this CMR system and suggest that the polarons retain some identity even at temperatures significantly below (Tc).

NTIS

Charge Transfer; Spin Dynamics; Lanthanum Compounds; Calcium Compounds; Manganese Oxides; Holes (Electron Deficiencies); Magnetoresistivity

19990028389 Toledo Univ., Dept. of Chemistry, OH USA

Experimental Charge Densities and Electrostatic Potentials in Energetic Materials and Infrastructure Upgrade for an X-ray Crystallography Laboratory ***Final Report***

Miller, R.; Goldwasser, J.; Jan. 1998; 485p; In English

Contract(s)/Grant(s): N00014-95-1-0013; N00014-97-1-0409

Report No.(s): AD-A360087; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

The objectives of this contract are: (1) to install a state-of-the-art X-ray crystallography laboratory with a new diffractometer using CCD area detector technology and develop data collection and data reduction protocols for charge density studies; (2) to compare charge density results from a CCD detector to those obtained by conventional diffractometers; (3) to fully evaluate the suitability of CCD detectors for the experimental study of electron density distributions and the derived electrostatic potentials; (4) to develop, optimize and calibrate a new helium cooling system for X-ray diffraction for ultra low temperature measurements; (5) to experimentally map the electron density distribution and derived electrostatic potentials in series of related solid energetic materials of differing shock sensitivities from high angle, low temperature X-ray diffraction data; (6) to develop methods of graphical representation of charge densities and electrostatic potentials; (7) to measure the anisotropy of thermal expansion parameters for energetic materials; (8) To relate the thermal expansion to molecular thermal motion; (9) to develop the necessary protocols for compressibilities studies on a CCD diffractometer; (10) To measure the compressibility of energetic materials; (11) to investigate possible cations compatible with the dinitramide anion to form high density salts; and (12) to provide crystal structures of energetic materials to others in the field.

DTIC

X Ray Diffraction; Density Distribution; Crystallography; Electrostatic Charge; Diffractometers; Electron Density (Concentration); Cooling Systems

19990028402 Department of Energy, Washington, DC USA

Electrical conductivity of compressed argon

Bauer, R., Department of Energy, USA; Windl, W., Department of Energy, USA; Collins, L., Department of Energy, USA; Kress, J., Department of Energy, USA; Kwon, I., Department of Energy, USA; Oct. 31, 1997; 9p; In English; 11th; Pulsed Power, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-000829; LA-UR-97-2662; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report calculations of the electrical conductivity of solid argon as a function of compression within the density functional local density approximation formulation for a norm-conserving pseudopotential using both electron-phonon coupling and molecular dynamics techniques.

NTIS

Argon; Electrical Resistivity; Computation; Compression Loads

19990028408 Department of Energy, Office of Energy Research, Washington, DC USA

Investigation of Mn Implanted LiNbO3 applying electron paramagnetic resonance technique

Darwish, A., Department of Energy, USA; Ila, D., Department of Energy, USA; Poker, D. B., Department of Energy, USA; Hensley, D. K., Department of Energy, USA; Oct. 31, 1997; 13p; In English; 9th; Radiation Effects in Insulators (REI-9), USA

Report No.(s): DE98-000690; ORNL/CP-94844; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effect of ion implantation on the LiNbO3 crystal is studied using electron paramagnetic resonance spectroscopy (EPR). EPR measurements on these crystals were performed as a function of ion species Mn and Fe and fluence at room temperature. Also the effect of the laser illumination on the EPR signal was determined by illuminating the crystal in situ and measuring the decay and growth of the EPR signal. LiNbO3:Mn(2+) at a depth of approximately 200 nm was formed by implantation of 2.5 x 10(exp 14) Mn/sq cm and 1 x 10(exp 17) Mn/sq cm at 2 MeV. The implanted samples were compared with bulk doped crystals. It was found that the decay and growth of Mn EPR for the implanted crystal is very small compared with the bulk doped LiNbO3:Mn crystal. This was found to be primarily due to the spin concentration on the crystals. On the other hand, the decay time of the high fluence is about 40% slower than the decay of the low fluence implanted crystal.

NTIS

Ion Implantation; Lithium Compounds; Niobates; Research; Manganese; Technology Transfer

19990028468 National Inst. of Standards and Technology, Gaithersburg, MD USA

Journal of Research of the National Institute of Standards and Technology, Volume 103

July - August 1998; 106p; In English

Report No.(s): PB99-114571; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This current issue includes the following topics: Thermal Conductivity of Magnesium Oxide From Absolute, Steady-State Measurements; Comparison of the NIST and ENEA Air Kerma Standards; Liquidus Diagram of the Ba-Y-Cu-O System in the Vicinity as the Ba2 YCu3O6+x Phase Field; The Refinement-Tree Partition for Parallel Solution of Partial Differential Equations. NTIS

Magnesium Oxides; Thermal Conductivity; Liquidus

19990028482 Department of Energy, Office of Energy Research, Washington, DC USA

Characterization of the structure and polarity of twin boundaries in GaP

Cohen, D., Department of Energy, USA; Medlin, D. L., Department of Energy, USA; Carter, C. B., Department of Energy, USA; Apr. 30, 1998; 8p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-052857; SAND-98-8550C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The structure of planar defects in GaP films grown by MBE on Si (110) was investigated by transmission electron microscopy. Growth of GaP films on the (110) surface produced numerous microtwins which formed both first and second order twin boundaries. Using high-resolution transmission electron microscopy, the atomic structure of (Sigma) = 3 and (Sigma) = 9 twin boundaries were studied. Both the (Sigma) = 3 and (Sigma) = 9 interfaces were observed to facet along specific crystallographic planes. Geometric models of the (Sigma) = 9 (l-brace)221(r-brace) twin boundary accounting for different polar bonding configurations were proposed and compared with experimental observations.

NTIS

Crystal Structure; Gallium Phosphides; Thin Films; Research; Flat Surfaces; Defects; Atomic Structure

19990028526 Department of Energy, Office of Energy Research, Washington, DC USA

Doping of GaN by ion implantation: Does It Work

Suvkhanov, A., Department of Energy, USA; Wu, W., Department of Energy, USA; Price, K., Department of Energy, USA; Parikh, N., Department of Energy, USA; Irene, E., Department of Energy, USA; Apr. 30, 1998; 8p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-005655; ORNL/CP-98016; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Epitaxially grown GaN by metal organic chemical vapor deposition (MOCVD) on SiC were implanted with 100 keV Si(sup +) (for n-type) and 80 keV Mg(sup +) (for p-type) with various fluences from 1 (times) 10(sup 12) to 7 (times) 10 (sup 15) ions/cm(sup 2) at liquid nitrogen temperature (LT), room temperature (RT), and 700 C (HT). High temperature (1,200 C and 1,500 C) annealing was carried out after capping the GaN with epitaxial AlN by MOCVD to study damage recovery. Samples were capped by a layer of AlN in order to protect the GaN surface during annealing. Effects of implant temperature, damage and dopant activation are critically studied to evaluate a role of ion implantation in doping of GaN. The damage was studied by Rutherford Backscattering/Channeling, spectroscopic ellipsometry and photoluminescence. Results show dependence of radiation damage level on temperature of the substrate during implantation: implantations at elevated temperatures up to 550 C decrease the lattice disorder; hot implants above 550 C can not be useful in doping of GaN due to nitrogen loss from the surface. SE measurements have indicated very high sensitivity to the implantation damage. PL measurements at LT of 80 keV Mg(sup +) (5 (times) 10(sup 14) cm(sup 2)) implanted and annealed GaN showed two peaks: one (approximately) 100 meV and another (approximately) 140 meV away from the band edge.

NTIS

Annealing; Ion Implantation; Metalorganic Chemical Vapor Deposition; Gallium Nitrides; Doped Crystals; Silicon; Temperature Effects; Conferences

19990028626 Department of Energy, Office of Energy Research, Washington, DC USA

Epitaxial YBa2Cu3O7 films on rolled-textured metals for high temperature superconducting applications

Norton, D. P., Department of Energy, USA; Park, C., Department of Energy, USA; Prouteau, C., Department of Energy, USA; Apr. 30, 1998; 33p; In English; 4th; Oxide Electronics, USA

Report No.(s): DE98-004817; ORNL/CP-97526; CONF-971236; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The epitaxial growth of high temperature superconducting (HTS) films on rolled-textured metal represents a viable approach for long-length superconducting tapes. Epitaxial, 0.5 micrometers thick YBa2Cu3O7 (YBCO) films with critical current densities, J(sub c), greater than 1 MA/sq cm have been realized on rolled-textured (001) Ni tapes with yttria-stabilized zirconia (YSZ)/CeO2 oxide buffer layers. This paper describes the synthesis using pulsed-laser deposition (PLD) of epitaxial oxide buffer layers on biaxially-textured metal that comprise the so-called rolling-assisted biaxially-textured substrates (RABiTs(trademark)).

The properties of the buffer and YBa2Cu3O7 films on rolled-textured Ni are discussed, with emphasis given to the crystallographic and microstructural properties that determine the superconducting properties of these multilayer structures.
NTIS
Vapor Phase Epitaxy; YBCO Superconductors; Superconducting Films; Yttria-Stabilized Zirconia

19990028811 Department of Energy, Office of Energy Research, Washington, DC USA
Transient grating in a KNbO3/KTaO3 superlattice
Liu, H., Department of Energy, USA; Fernandez, F., Department of Energy, USA; Jia, W., Department of Energy, USA; Boatner, L. A., Department of Energy, USA; Jun. 30, 1998; 9p; In English; 43rd; Optical science, engineering, and instrumentation, USA
Report No.(s): DE98-005662; ORNL/CP-98324; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Time-resolved degenerate-four-wave-mixing (DFWM) techniques have been used to characterize the nonlinear optical response of a KNbO3/KTaO3 superlattice grown by pulsed laser deposition on a 1 mm thick, (001)-oriented KTaO3 substrate. With a 30 psec pulsed laser, the difference in the nonlinear optical response between bulk KTaO3 and the superlattice was measured. Results indicate that a significant contribution to the response signal is due to the KNbO3 superlattice. The chi(sup 3) value was estimated to have increased by 2 orders of magnitude compared to the bulk crystal.
NTIS
Superlattices; Potassium Compounds; Niobium Oxides; Tantalum Oxides

19990031842 Department of Energy, Office of Energy Research, Washington, DC USA
Boron-enhanced diffusion of boron from ultralow-energy boron implantation
Agarwal, A., Department of Energy, USA; Eaglesham, D. J., Department of Energy, USA; Gossmann, H. J., Department of Energy, USA; Pelaz, L., Department of Energy, USA; Herner, S. B., Department of Energy, USA; May 03, 1998; 12p; In English; 8th; Silicon Materials Science and Technology, USA
Report No.(s): DE98-004111; ORNL/CP-96082; CONF-980528; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have investigated the diffusion enhancement mechanism of BED (boron enhanced diffusion), wherein the boron diffusivity is enhanced three to four times over the equilibrium diffusivity at 1,050 C in the proximity of a silicon layer containing a high boron concentration. It is shown that BED is associated with the formation of a fine-grain polycrystalline silicon boride phase within an initially amorphous Si layer having a high B concentration. For 0.5 keV B(+), the threshold implantation dose which leads to BED lies between 3 x 10(exp 14) and of 1 x 10(exp 15)/cm(exp -2). Formation of the shallowest possible junctions by 0.5 keV B(sup +) requires that the implant dose be kept lower than this threshold.
NTIS
Boron; Ion Implantation; Ionic Diffusion

19990031893 Department of Energy, Office of Energy Research, Washington, DC USA
Atomic-scale origins of grain boundary superconducting properties
Pennycook, S. J., Department of Energy, USA; Chisholm, M. F., Department of Energy, USA; Buban, J., Department of Energy, USA; Browning, N. D., Department of Energy, USA; Prouteau, C., Department of Energy, USA; Feb. 28, 1998; 5p; In English; Microscopy and microanalysis, 1998, USA
Report No.(s): DE98-005588; ORNL/CP-96745; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Due to the extremely short coherence lengths of the high-Tc superconductors, defects such as grain boundaries are obvious barriers to the flow of supercurrent. Within a few months of the discovery of these materials, it was shown how the critical current dropped four orders of magnitude as the grain boundary misorientation increased from zero to 45 deg. A qualitative understanding is however possible through atomic resolution Z-contrast imaging on YBa2Cu3(O7(-)(delta)) and SRTiO3 bicrystal grain boundaries, combined with bond-valence-sum analysis. The Z-contrast image of a YBa2Cu3(O7(-)(delta)) low angle grain boundary shows the same kind of reconstructed dislocation cores as seen in SRTiO3, containing reconstructions on both the Cu and Y/Ba sublattices. An image of an asymmetric 30 deg boundary in YBa2 Cu3(O7(-)(delta)) shows the same units and unit sequence as expected for SRTiO3. YBa2Cu3(O7(-)(delta)) boundaries are wavy because of their non- equilibrium growth process, and therefore mostly asymmetric in nature, although small segments have the symmetric structure. It seems reasonable to assume that boundaries of other angles will also have similar structures in these two materials.
NTIS
Atoms; Grain Boundaries; Superconductivity

19990031934 Department of Energy, Washington, DC USA

Correlation of intermediate ion energy induced extended defect continuity to enhanced pinning potential in Tl-2212 films

Newcomer, P. P., Department of Energy, USA; Venturini, E. L., Department of Energy, USA; Doyle, B. L., Department of Energy, USA; Brice, D. K., Department of Energy, USA; Schoene, H., Department of Energy, USA; Dec. 31, 1998; 8p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-003554; SAND-98-1418C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Lattice defects are introduced into the structure to suppress the motion of magnetic vortices and enhance the critical current density in high temperature superconductors. Point defects are not very effective pinning sites for the cuprate superconductors; however, extended defects, such as linear tracks, have been shown to be strong pinning sites. The authors study the superconducting cuprate Tl-2212 (the numbers designate Ti-Ba-Ca-Cu stoichiometry). Large enhancements of vortex pinning potential were observed in Tl-2212 after high-intermediate energy heavy-ion irradiations where non-continuous extended defects were induced at dE/dx of 9 to 15.2 keV/nm (60 MeV Au, 60 MeV Cu, and 30 MeV Au) and continuous linear defects were induced at 19.5 keV/nm (88 MeV Au). Their research addresses the question of pinning in highly anisotropic materials like Tl-2212 where the vortices are pancakes rather than rods and suitable defect structures may be discontinuous extended damage domains. The defect microstructure and the effectiveness of the pinning potential in Tl-2212 after irradiation by intermediate energy Au at lower dE/dx of 5--15 keV/nm, where recoils are more significant, is studied using high resolution transmission electron microscopy digital imaging and a SQUID magnetometer. The nature of the ion irradiation damage at these intermediate dE/dx will be correlated to the average vortex pinning potential and the TRIMRC calculations for recoils.

NTIS

Correlation; Ion Irradiation; Pinning; Thin Films; Anisotropy; Crystal Defects; Superconductors (Materials)

19990031978 Department of Energy, Office of Energy Research, Washington, DC USA

Grain Boundary Studies of Doped Yttria-Stabilized Zirconia

Evans, N. D., Department of Energy, USA; Imamura, P. H., Department of Energy, USA; Mecartney, M. L., Department of Energy, USA; Bentley, J., Department of Energy, USA; Mar. 31, 1998; 4p; In English; 14th; Electron Microscopy, USA

Report No.(s): DE98-005719; ORNL/CP-97403; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Achieving superplasticity in fine-grained ceramics is a potential method to lower energy costs associated with ceramic manufacturing via net shape forming. Superplasticity is intrinsic in 3-mol%-yttria-stabilized tetragonal zirconia polycrystals (3Y-TZP), and can be enhanced by addition of glass to form intergranular phases which are thought to both limit grain growth and promote grain boundary sliding. However, superplasticity has not been observed in 8-mol%-yttria-stabilized cubic zirconia (8Y-CSZ), ostensibly due to its larger grain size and high grain growth rates. As part of a larger study, high-spatial-resolution energy-dispersive X-ray spectrometry (EDS) has been performed to characterize intergranular compositions of 3Y-TZP and 8Y-CSZ doped with various glassy phases.

NTIS

Yttria-Stabilized Zirconia; Grain Boundaries; Superplasticity; Doped Crystals; Ceramics

19990031982 Department of Energy, Office of Energy Research, Washington, DC USA

Investigation of epitaxial silicon layers as a material for radiation hardened silicon detectors

Li, Z., Department of Energy, USA; Eremin, V., Department of Energy, USA; Ilyashenko, I., Department of Energy, USA; Ivanov, A., Department of Energy, USA; Verbitskaya, E., Department of Energy, USA; Dec. 31, 1997; 9p; In English; Nuclear Science, USA, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE98-004434; BNL-64973/98/3-REV; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Epitaxial grown thick layers (less than 100 micrometers) of high resistivity silicon (Epi-Si) have been investigated as a possible candidate of radiation hardened material for detectors for high-energy physics. As grown Epi-Si layers contain high concentration (up to 2 x 10(exp 12) /cu cm) of deep levels compared with that in standard high resistivity bulk Si. After irradiation of test diodes by protons (E(sub p) = 24 GeV) with a fluence of 1.5 x 10(exp 11) /sq cm, no additional radiation induced deep traps have been detected. A reasonable explanation is that there is a sink of primary radiation induced defects (interstitial and vacancies), possibly by as-grown defects, in epitaxial layers. The 'sinking' process, however, becomes non-effective at high radiation fluences (10(exp 14) /sq cm) due to saturation of epitaxial defects by high concentration of radiation induced ones. As a result, at neutron fluence of 1 x 10(exp 14) /sq cm the deep level spectrum corresponds to well-known spectrum of radiation induced defects in high

resistivity bulk Si. The net effective concentration in the space charge region equals to 3 x 10(exp 12) /cu cm after 3 months of room temperature storage and reveals similar annealing behavior for epitaxial as compared to bulk silicon.
NTIS
Silicon; Epitaxy; Semiconductor Devices; Research; Barrier Layers; Electrical Resistivity; Diodes; Defects

19990031990 Department of Energy, Office of Energy Research, Washington, DC USA
Vacancy supersaturations produced by high-energy ion implantation
Venezia, V. C., Department of Energy, USA; Eaglesham, D. J., Department of Energy, USA; Jacobson, D. C., Department of Energy, USA; Gossmann, H. J., Department of Energy, USA; Haynes, T. E., Department of Energy, USA; Jan. 31, 1998; 14p; In English; 8th; Silicon Materials Science and Technology, USA
Report No.(s): DE98-004112; ORNL/CP-96088; CONF-980528; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new technique for detecting the vacancy clusters produced by high-energy ion implantation into silicon is proposed and tested. This technique takes advantage of the fact that metal impurities, such as Au, are gettered near one-half of the projected range ((1/2)R(sub p)) of MeV implants. The vacancy clustered region produced by a 2 MeV Si(+) implant into silicon has been labeled with Au diffused in from the front surface. The trapped Au was detected by Rutherford backscattering spectrometry (RBS) to profile the vacancy clusters. Cross section transmission electron microscopy (XTEM) analysis shows that the Au in the region of vacancy clusters is in the form of precipitates. by annealing MeV implanted samples prior to introduction of the Au, changes in the defect concentration within the vacancy clustered region were monitored as a function of annealing conditions.
NTIS
Ion Implantation; Supersaturation; Vacancies (Crystal Defects)

19990032159 Department of Energy, Washington, DC USA
Effects of irradiation and isochronal anneal temperature on hole and electron trapping in MOS devices
Fleetwood, D. M., Department of Energy, USA; Winokur, P. S., Department of Energy, USA; Shaneyfelt, M. R., Department of Energy, USA; Riewe, L. C., Department of Energy, USA; Flament, O., Department of Energy, USA; Feb. 28, 1998; 7p; In English; Nuclear and Space Radiation Effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-004964; SAND-98-0381C; CONF-980705; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Capacitance-voltage and thermally-stimulated-current techniques are used to estimate trapped hole and electron densities in MOS oxides as functions of irradiation and isochronal anneal temperature. Trapped-charge annealing and compensation effects are discussed.
NTIS
Electrical Properties; Semiconductor Devices; Irradiation; Annealing

19990032235 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Local atomic structure of La(1 - x)SR(x)CoO3: Effects induced by the spin-state and non-metal to metal transitions
Louca, D., Department of Energy, USA; Sarrao, J. L., Department of Energy, USA; Kwei, G. H., Department of Energy, USA; Mar. 31, 1998; 9p; In English
Report No.(s): DE98-004385; LA-UR-97-5151; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The pair density function (PDF) used in the analysis of pulsed neutron diffraction data of La(1 - x)SR(x)CoO3 revealed new structural effects which are correlated to the susceptibility and transport transitions. The transition in the spin configuration of the Co ions from the low-spin (LS) to the high-spin (HS) state in the Co perovskite oxides can potentially induce structural distortions due to the coupling of the spin to the lattice and charge. The ground state of the pure compound, LaCoO3, is in the LS state and is non-magnetic. A transition occurs to the HS state at (approximately) 50 K as indicated from the susceptibility measurements due to the thermal excitation of electrons to the e(sub g) level. The Co(sub LS)O6 octahedra associated with the Co ions in the LS configuration are distinguished from the Co(sub HS)O6 octahedra with the Co in the HS configuration because the Co(sub LS)-O bond length is shorter than the Co(sub HS)-O distance due to the different size of the corresponding Co ions. Such bond lengths are clearly identified in the local structure between 15--300 K. This finding is in contrast to the average structure which shows only one type of bond length in this temperature range but two types of bond lengths are suggested at considerably higher temperatures. This suggests that whereas the LS and HS CoO6-octahedra coexist, they are randomly distributed in the crystal lattice at lower temperatures and become ordered at higher temperatures.
NTIS
Crystal Structure; Lanthanum Oxides; Strontium Compounds; Cobalt Oxides; Crystal Lattices; Atomic Structure

19990032393 Department of Energy, Office of Energy Research, Washington, DC USA

Analysis of grain boundaries, twin boundaries, and Te precipitates in CdZnTe grown by high-pressure Bridgeman method

Heffelfinger, J. R., Department of Energy, USA; Medlin, D. L., Department of Energy, USA; James, R. B., Department of Energy, USA; Mar. 31, 1998; 9p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-052518; SAND-98-8457C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Grain boundaries and twin boundaries in commercial Cd(sub 1 - x)Zn(sub x)Te, which is prepared by a high pressure Bridgeman technique, have been investigated with transmission electron microscopy, scanning electron microscopy, infrared light microscopy and visible light microscopy. Boundaries inside these materials were found to be decorated with Te precipitates. The shape and local density of the precipitates were found to depend on the particular boundary. For precipitates that decorate grain boundaries, their microstructure was found to consist of a single, saucer shaped grain of hexagonal Te (space group P3(sub 1)21). Analysis of a Te precipitate precipitates by selected area diffraction revealed the Te to be aligned with the surrounding Cd(sub 1(minus)x)Zn(sub x)Te grains. This alignment was found to match the (111) Cd(sub 1 - x)Z(x)Te planes with the (1(bar 1)01) planes of hexagonal Te. Crystallographic alignments between the Cd(sub 1 - x)Zn(x)Te grains were also observed for a high angle grain boundary. The structure of the grain boundaries and the Te/Cd(sub 1 - x)Zn(x)Te interface are discussed.

NTIS

Microstructure; Research; Crystallography; Grain Boundaries; Tellurium; Particle Precipitation

19990032416 Department of Energy, Washington, DC USA

Conduction band mass determinations for n-type InGaAs/InAlAs single quantum wells

Jones, E. D., Department of Energy, USA; Reno, J. L., Department of Energy, USA; Kotera, N., Department of Energy, USA; Wang, Y., Department of Energy, USA; May 31, 1998; 7p; In English; Photonics, 1998, Taiwan, Province of China

Report No.(s): DE98-005453; SAND-98-0111C; CONF-980729; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report the measurement of the conduction band mass in n-type single 27-ML-wide InGaAs/InAlAs quantum well lattice matched to InP using two methods: (1) Magnetoluminescence spectroscopy and (2) far-infrared cyclotron resonance. The magnetoluminescence method utilizes Landau level transitions between 0 and 14 T at 1.4 K. The far infrared cyclotron resonance measurements were made at 4.2 K and to fields as large up to 18 T. The 2D-carrier density N(sub 2D) = 3 x 10(exp 11) cm(exp -2) at low temperatures. The magnetoluminescence technique yielded an effective conduction-band mass of m(sub c) = 0.062m(sub 0) while the far infrared cyclotron resonance measurements gave m(sub c) = 0.056m(sub 0), where m(sub 0) is the free electron mass. Both measurements show no evidence for any significant conduction-band nonparabolicity.

NTIS

Conduction Bands; Electron Mass; N-Type Semiconductors; Indium Gallium Arsenides; Indium Aluminum Arsenides; Quantum Wells

19990032417 Department of Energy, Washington, DC USA

Characterization of heavy masses of two-dimensional conduction subband in InGaAs/InAlAs MQW structures by pulsed cyclotron resonance technology

Kotera, N., Department of Energy, USA; Tanaka, K., Department of Energy, USA; Arimoto, H., Department of Energy, USA; Miura, N., Department of Energy, USA; Jones, E. D., Department of Energy, USA; May 31, 1998; 10p; In English; photonics, 1998, Taiwan, Province of China; Sponsored by International Society for Optical Engineering, USA

Report No.(s): DE98-005452; SAND-97-3155C; CONF-980729; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Conduction-band effective masses in a direction parallel to the quantum well plane were investigated in n-type-modulation-doped InGaAs/InAlAs multiquantum well system. Thicknesses of well and barrier were 5 and 10 nm. Three highly-doped specimens having about 1 x 10(exp 12) cm(exp -2) per one quantum well were prepared by MBE. Double-crystal X-ray diffraction was used to check the crystal quality. Heavy electron effective masses, almost 50% bigger than the band edge mass of 0.041 m(sub 0), were measured by far-infrared and infrared cyclotron resonances under pulse high magnetic fields up to 100 T. Nonparabolicity of this subband was less than 12% by comparing the two different from conduction-band effective mass in a direction perpendicular to the same quantum well and from GaAs/GaAlAs quantum well system.

NTIS

Electron Mass; Conduction Bands; Indium Gallium Arsenides; Indium Aluminum Arsenides; Cyclotron Resonance

19990032533 Department of Energy, Washington, DC USA

Effect of impurities and stress on the damage distributions of rapidly grown KDP crystals

Runkel, M., Department of Energy, USA; Tan, M., Department of Energy, USA; DeYoreo, J., Department of Energy, USA; Zaitseva, N., Department of Energy, USA; Dec. 20, 1997; 15p; In English; 29th; Optical materials for high power lasers, USA

Report No.(s): DE98-052077; UCRL-JC-128091; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Development of high damage threshold, 50 cm, rapidly grown KF*P frequency triplers for operation of the National Ignition Facility (NIF) in the 14 J/cm2, 351 nm, 3 ns regime requires a thorough understanding of how the crystal growth parameters and technologies affect laser induced damage. of particular importance is determining the effect of ionic impurities (e.g. Cr(3+), Fe(3+), Al(3+)) which may be introduced in widely varying concentrations via starting salts. In addition, organic particulates can contaminate the solution as leachants from growth platforms or via mechanical ablation. Mechanical stresses in the crystals may also play a strong role in the laser-induced damage distribution (LIDD), particularly in the cases of large boules where hydrodynamic forces in damage test system with diagnostic capabilities specifically designed for measured time resolved bulk damage onset and evolution. The data obtained make it possible to construct characteristic damage threshold distributions for each sample. Test results obtained for a variety of KDP samples grown from high purity starting salts and individually doped with Lucite and Teflon, iron, chromium, and aluminium show that the LIDD drops with increasing contamination content. The results also show that solution filtration leads to increased damage performance for undoped crystals but is not solely responsibility for producing the high LIDDs required by the NIF. The highest LIDD measured on a rapidly grown sample indicate that it is possible to produce high damage threshold material using ultrahigh purity, recrystallized starting salts, continuous filtration and a platform designed to minimize internal stress during growth.

NTIS

Impurities; Crystal Growth; Stress Distribution; Laser Damage; Doped Crystals

77
THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also 25 Inorganic and Physical Chemistry and 34 Fluid Mechanics and Heat Transfer.

19990028478 Department of Energy, Office of Energy Research, Washington, DC USA

Matrix description of (1,0) theories in six dimensions

Aharony, O., Department of Energy, USA; Berkooz, M., Department of Energy, USA; Kachru, S., Department of Energy, USA; Silverstein, E., Department of Energy, USA; Sep. 30, 1997; 17p; In English

Report No.(s): DE98-059138; SLAC-PUB-7648; IASSNS-HEP-97/99,UCB-PTH-97/45; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors propose descriptions of interacting (1,0) supersymmetric theories without gravity in six dimensions in the infinite momentum frame. They are based on the large N limit of quantum mechanics or 1 + 1 dimensional field theories with SO(N) gauge group and four supercharges. They argue that this formulation allows for a concrete description of the chirality-changing phase transitions which connect (1,0) theories with different numbers of tensor multiplets.

NTIS

Dimensions; Matrix Theory; Supersymmetry; Measuring Instruments

19990028517 Department of Energy, Office of Energy Research, Washington, DC USA

Vacuum energy cancellation in a non-supersymmetric string

Kachru, S., Department of Energy, USA; Kumar, J., Department of Energy, USA; Silverstein, E., Department of Energy, USA; Aug. 31, 1998; 28p; In English

Report No.(s): DE98-059250; SLAC-PUB-7875; LBNL-41932; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present a nonsupersymmetric orbifold of type 2 string theory and show that it has vanishing cosmological constant at the one and two loop level. They argue heuristically that the cancellation persists at higher loops.

NTIS

Supersymmetry; Vacuum; String Theory

80
SOCIAL SCIENCES (GENERAL)

Includes educational matters.

19990032580 Nebraska Univ., Aviation Inst., Omaha, NE USA
NASA Nebraska Space Grant Consortium 1995-1999 Self Evaluation, *1995-1999*
Schaaf, Michaela M., Nebraska Univ., USA; Bowen, Brent D., Nebraska Univ., USA; Schaffart, Mary M., Nebraska Univ., USA; January 1999; 32p; In English
Contract(s)/Grant(s): NAGw-4414
Report No.(s): UNOAI-99-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NASA Nebraska Space Grant Consortium receives funds from NASA to allow Nebraska colleges and universities to implement balanced programs of research, education and public service related to aeronautics, space science and technology. Nebraska is a capability enhancement state which directs efforts and resources toward developing research infrastructure and enhancing the quality of aerospace research and education for all Nebraskans. Furthermore, the Nebraska Space Grant strives to provide national leadership in applied aspects of aeronautics. Nebraska has met, meets and will continue to meet all requirements set forth by NASA. Nebraska is a top-tier consortium and will continue to be a model program.
Author
Education; Universities; Organizations; Technologies; Research and Development

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

19990032096 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Evolution of cooperative behavior in simulation agents
Stroud, P. D., Department of Energy, USA; Apr. 30, 1998; 12p; In English; 12th; Aerospace/defense sensing, simulation and controls, USA
Report No.(s): DE98-005275; LA-UR-98-73; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A simulated automobile factory paint shop is used as a testbed for exploring the emulation of human decision making behavior. A discrete events simulation of the paint shop as a collection of interacting Java actors is described. An evolutionary cognitive architecture is under development for building software actors to emulate humans in simulations of human dominated complex systems. In this paper, the cognitive architecture is extended by implementing a persistent population of trial behaviors with an incremental fitness valuation update strategy, and by allowing a group of cognitive actors to share information. A proof of principle demonstration is presented.
NTIS
Human Behavior; Decision Making; Computerized Simulation; Human Factors Engineering

82
DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

19990028327 Department of Energy, Office of Energy Research, Washington, DC USA
US nuclear reaction data program in support of basic research
Bhat, M. R., Department of Energy, USA; Chadwick, M. B., Department of Energy, USA; Smith, M. S., Department of Energy, USA; Mar. 31, 1998; 8p; In English; Nuclear data for science and technology, USA
Report No.(s): DE98-004251; LA-UR-97-5015; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Information about the US Nuclear Reaction Data Network (USNRDN) such as its members, work in progress, summaries of meetings, and organizational details may be found in its WWW Homepage. This paper is an overview of the data support pro-

vided by the network for basic research in nuclear astrophysics, radioactive ion beams, high energy heavy ion and electron interactions and related activities involving all aspects of data stewardship.
NTIS
Nuclear Reactions; Information Dissemination; Nuclear Astrophysics; Research

19990028530 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Electronic full-image reports at Los Alamos National Laboratory
Mosier, M. L., Department of Energy, USA; Mar. 02, 1998; 9p; In English, 1998, USA; Sponsored by American Society for Engineering Education, USA
Report No.(s): DE98-004232; LA-UR-97-4641; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Los Alamos National Laboratory is a Department of Energy laboratory operated by the University of California. There are over 10,000 laboratory employees and contractors, many engaged in a variety of scientific and technical research. The laboratory covers forty-three square miles in northern New Mexico, one hundred miles from the nearest city which might reasonably be expected to meet the needs of the researchers. Because of the remoteness of the institution, the Research Library is a vital source for scientific and technical information. Due to the size of the institution, access to the physical library is difficult. These barriers, along with advances in technology, have led the Research Library to provide desktop access to all formal, unlimited Los Alamos reports. Older reports have been scanned and newer ones are received in electronic format. Currently over 10,000 reports are available in portable document format (PDF) via the World Wide Web (http://lib- www.lanl.gov). Researchers can search the library Web catalog (on a Z39.50 server), find a report, and click on a link to automatically bring up the report. This has been an extremely successful project as shown by the high usage, over 3,000 files retrieved per month in 1997 compared with around 100 for the hardcopy. This paper will discuss the reasons for, and the mechanics of, digitizing the reports, the results that have been observed, and plans for the future.
NTIS
Records Management; Information Dissemination; Information Systems

19990028534 Department of Energy, Washington, DC USA
Collaborative development of a US/Russia safety information center database
Dvorack, M. A., Department of Energy, USA; Smith, R. E., Department of Energy, USA; Ananiychuk, V. N., Department of Energy, USA; Volkova, N. A., Department of Energy, USA; Jan. 31, 1998; 9p; In English; ESREL 1998: European Safety and Reliability, USA
Report No.(s): DE98-004219; SAND-98-0247C; CONF-980621; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

One of the major outgrowths resulting from the collapse of the former Soviet Union (FSU) has been an increase in technical information exchange and dialogue between the Russian and American nuclear weapons laboratories. One area of such discussions is concerned with the safety of low probability, high consequence systems and operations. In order to further the understanding between the respective institutes in this important area, a collaborative effort has been established between Sandia National Laboratories and the two premier Russian nuclear weapons laboratories, Arzamas-16 and Chelyabinsk-70, in which a common database has been developed which contains safety information provided by all three laboratories. More than 1,200 documents have been placed by the three institutes into this database. This paper describes the details of this data base, including the types of safety information being stored.
NTIS
Safety; Data Bases; International Cooperation; Data Base Management Systems

19990031942 Newcastle Univ., Dept. of Computing Science, Newcastle, UK
Constructing Standards for Cross-Platform Operation
Rossiter, B. N., Newcastle Univ., UK; Heather, M., Newcastle Univ., UK; June 1998; 24p; In English
Report No.(s): PB99--122657; TRS-623; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A universal representation is developed, based on the ISO standards for Information Resource Dictionary System (IRDS), with the aim of providing a complete definition of an information system from the physical data values held to the concepts employed for data and function description and real-world abstractions. It is discussed how such a multi-level model can be used to control the evolution of information systems by creating an environment where heterogeneous systems can be compared. Current trends towards more structured programming techniques and more disciplined software engineering environments lead to the potential for considerable benefits from using an IRDS approach. This potential, however, will only be realised if a formal underpinning of the IRDS standard is achieved and then only reliably if the (/it formal) is constructive and the underpinning is

enabling not just supporting. The ISO standard Information Resource Dictionary System (IRDS) can be shown to have the appropriate formal basis to perform the role of a universal reference model.
NTIS
Standards; Heterogeneity; Programming Environments; Structured Programming

19990032029 Department of Energy, Office of Energy Research, Washington, DC USA
Digitizing legacy documents: A knowledge-base preservation project
Sep. 30, 1998; 23p; In English
Report No.(s): DE98-058923; FNAL-TM-2056; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As more library customers and staff throughout the world come to rely upon rapid electronic access to fulltext documents, there is increasing demand to also make older documents electronically accessible. Illinois State Library grant funds allowed us to purchase hardware and software necessary to answer this demand. We created a production system to scan our legacy documents, convert them into Portable Document Format (PDF), save them to a server for World Wide Web access, and write them to CD discs for distribution.
NTIS
Computer Programs; Computers; Data Base Management Systems; Knowledge Based Systems; Documents

19990032117 Joint Advanced Distributed Simulation Joint Test Force, Albuquerque, NM USA
Collection and Analysis of Quality Data in a Distributed Simulation Test Environment
Gonzalez, Dean G.; Black, Jerry; Jan. 1998; 22p; In English
Report No.(s): AD-A359418; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Since T&E using ADS is relatively new and continues to evolve, there are a paucity of tools available for general use that allow new T&E ADS personnel to evaluate the quality of their ADS system The quality focus of the tools presented is upon tools to assist in the detection of time errors, network-induced errors, and PDU-generation errors. Tools were developed that proved useful. These will be presented. The purpose of JADS testing is to assess the utility of ADS for T&E. This purpose is being accomplish through the execution of three distinctly separate tests. The first of these is called the System Integration Test (SIT). The first phase of this test is the Linked Simulators Phase (LSP). It is this first phase of the first test that has recently been completed and which is the basis for the tools presented. The SIT LsP tests simulate a shooter aircraft launching an air-to-air missile against a target aircraft. The shooter, target, and missile are represented by geographically separated simulators. The shooter is represented by the F/A-18 Weapon System Support Facility (WSSF) at China lake, CA. The missile is the AIM-9 Sidewinder Simulation laboratory (SIMLAB), also at China Lake, CA. The target is represented by the F-14 Weapons System Integration Center (WSIC) at Point Mugu, CA. Test control of this distributed test will be done from the Test Control and Analysis Center (TCAC) located at the JADS JTF in Albuquerque, NM. The SIT LsP test replicates a ”baseline” live fire test. The test evaluation method is to compare ADS test results with results from the identical ”baseline” test (This is a simplified view of the JADS testing... but it suffices for this discussion). Data collection and storage, the data analysis system, and time synchronization topics are reviewed as preparatory material for the presentation of the tools that have been developed.
DTIC
Data Acquisition; F-18 Aircraft; Air to Air Missiles; Data Simulation; F-14 Aircraft; Computerized Simulation; Systems Integration

19990032123 Department of Energy, Washington, DC USA
DataFoundry: Warehousing techniques for dynamic environments
Critchlow, T., Department of Energy, USA; Fidelis, K., Department of Energy, USA; Ganesh, M., Department of Energy, USA; Musick, R., Department of Energy, USA; Slezak, T., Department of Energy, USA; Jan. 29, 1998; 15p; In English
Report No.(s): DE98-058751; UCRL-JC-129576; CONF-9806115; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Data warehouses and data marts have been successfully applied to a multitude of commercial business applications as tools for integrating and providing access to data located across an enterprise. Although the need for this capability is as vital in the scientific world as in the business domain, working warehouses in our community are scarce. A primary technical reason for this is that our understanding of the concepts being explored in an evolving scientific domain change constantly, leading to rapid changes in the data representation. When any database providing information to a warehouse changes its format, the warehouse must be updated to reflect these changes, or it will not function properly. The cost of maintaining a warehouse using traditional techniques in this environment is prohibitive. This paper describes ideas for dramatically reducing the amount of work that must be done to keep a warehouse up to date in a dynamic, scientific environment. The ideas are being applied in a prototype warehouse

called DataFoundry. DataFoundry, currently in use by structural biologists at LLNL, will eventually support scientists at the Department of Energy's Joint Genome Institute.
NTIS
Data Management; Data Bases

19990032175 Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA
Information architecture, Volume 4, Vision
Mar. 31, 1998; 126p; In English
Report No.(s): DE98-005228; DOE/HR-0190; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Vision document marks the transition from definition to implementation of the Department of Energy (DOE) Information Architecture Program. A description of the possibilities for the future, supported by actual experience with a process model and tool set, points toward implementation options. The directions for future information technology investments are discussed. Practical examples of how technology answers the business and information needs of the organization through coordinated and meshed data, applications, and technology architectures are related. This document is the fourth and final volume in the planned series for defining and exhibiting the DOE information architecture. The targeted scope of this document includes DOE Program Offices, field sites, contractor-operated facilities, and laboratories. This document paints a picture of how, over the next 7 years, technology may be implemented, dramatically improving the ways business is conducted at DOE. While technology is mentioned throughout this document, the vision is not about technology. The vision concerns the transition afforded by technology and the process steps to be completed to ensure alignment with business needs. This goal can be met if those directing the changing business and mission-support processes understand the capabilities afforded by architectural processes.
NTIS
Information Systems; Architecture; Vision; Data Base Management Systems

19990032200 Environmental Protection Agency, Office of Administration and Resources Management, Cincinnati, OH USA
EPA National Publications Catalog, 1998: Fourth Edition
March 1998; 846p; In English
Report No.(s): PB99--124323; EPA/200/B-98/001; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

This is the 1998 edition of the EPA National Publications Catalog. As in the past editions, this fourth edition continues to offer current Agency publications available from EPA Headquarters, Regions and Laboratories on a wide variety of environmental issues.
NTIS
Catalogs (Publications); Research and Development; Pollution Control; Environment Management

19990032261 Department of Energy, Office of Energy Research, Washington, DC USA
Nuclear data online
McLane, V., Department of Energy, USA; Dec. 31, 1997; 5p; In English
Report No.(s): DE98-004447; BNL-NCS-65270; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The National Nuclear Data Center (NNDC) Online Data Service, available since 1986, is continually being upgraded and expanded. Most files are now available for access through the World Wide Web. Bibliographic, experimental, and evaluated data files are available containing information no neutron, charged-particle, and photon-induced nuclear reaction data, as well as nuclear decay and nuclear structure information. An effort is being made through the world-wide Nuclear Reaction Data Centers collaboration to make the charged- particle reaction data libraries as complete as possible. The data may be downloaded or viewed both as plots or as tabulated data. A variety of output formats are available for most files.
NTIS
Bibliographies; On-Line Systems; Nuclear Structure; Data Bases; Internets

19990032370 Department of Energy, Office of Energy Research, Washington, DC USA
Updating problems in latent semantic indexing
Simon, H. D., Department of Energy, USA; Zha, H., Department of Energy, USA; Nov. 30, 1997; 12p; In English
Report No.(s): DE98-052316; LBNL-41101; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors develop new SVD-updating algorithms for three types of updating problems arising from Latent Semantic Indexing (LSI) for information retrieval to deal with rapidly changing text document collections. They also provide theoretical justifica-

tion for using a reduced-dimension representation of the original document collection in the updating process. Numerical experiments using several standard text document collections show that the new algorithms give higher (interpolated) average precisions than the existing algorithms and the retrieval accuracy is comparable to that obtained using the complete document collection.
NTIS
Information Retrieval; Algorithms; Indexes (Documentation)

19990032380 Defense Information Systems Agency, Falls Church, VA USA
Department of Defense Data Model, Version 1, FY 1999, Volume 8
Nov. 30, 1998; 571p; In English
Report No.(s): AD-A359586; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche
This section contains the DoD Data Model Entity Relationship Report. Listed herein is every relationship in the DoD Data Model in order of parent entity. There is one line of information per parent-child relationship. The information specified below appears within each line of the report.
DTIC
Data Bases; Data Base Management Systems

19990032381 Defense Information Systems Agency, Falls Church, VA USA
Department of Defense Data Model, Version 1, FY 1999, Volume 5
Nov. 30, 1998; 232p; In English
Report No.(s): AD-A359587; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche
The Person Subject Area View includes all data about Persons of interest to the DoD, knowledge about who is essential to the achievement of the DoD mission. It includes data on military and civilian Persons, including actual or potential friends and foes to the U.S.
DTIC
Data Bases; Data Base Management Systems

19990032386 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Explorer at Los Alamos: A library for the future
Waters, M., Department of Energy, USA; McDonald, J., Department of Energy, USA; Mar. 31, 1998; 9p; In English; System Sciences (HICSS 31), USA
Report No.(s): DE98-003306; LA-UR-97-4619; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Since 1993, Los Alamos National Laboratory, has been developing World Wide Web (WWW) applications to facilitate access to vast quantities of information critical to the successful operation of a nuclear weapons facility Explorer is a web-based tool that integrates full-text search and retrieval technology, custom user in interface faces, user-friendly navigation tools, extremely large document collections, and data collection and workflow applications. Explorer's first major thrust was to enable quick access to regulatory and policy information used by Department of Energy facilities throughout the country. Today, Explorer users can easily search document collections containing, millions of pages of information scattered across Web sites around the country. Over fifteen large applications containing multiple collections are searchable through Explorer, and the subject areas range from DOE regulations to quality management-related resources to technology transfer opportunities. Explorer has succeeded because it provides quick and easy access to stored data across the Web; it saves time and reduces costs in comparison with traditional information distribution, access, and retrieval methods.
NTIS
Subroutine Libraries (Computers); Information Retrieval; Information Systems

19990032520 Infodata Systems, Inc., Fairfax, VA USA
Multimedia Workshop
Lorber, Linda; Seiffert, Lea; Aug. 25, 1998; 159p; In English, 25 Aug. 1998, USA
Contract(s)/Grant(s): SPN4700-98-M-0478
Report No.(s): AD-A359745; DTIC*-TR--1998/12; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
The techniques of incorporating multimedia into technical reports, theses and dissertations are presented in this workbook which is associated with the video-teleconferenced presentation of 25 August 1998 at DLA Headquarters. The reader may learn how to incorporate audio, video, animation and photographs into documents. Documents are enhanced by the incorporation of

multimedia and add interactivity. Separate videos of the three-part Multimedia Workshop are available in DTIC's non-print collection.
DTIC
Multimedia; Theses; Reports

85
URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see also 03 Air Transportation and Safety, 16 Space Transportation, and 44 Energy Production and Conversion.

19990032504 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA
Midcourse Space Experiment Data Certification and Technology Transfer, Supplement 1 ***Final Report, 1 Apr. 1997 - 31 Mar. 1998***
Pollock, David B., Johns Hopkins Univ., USA; Nov. 12, 1998; 28p; In English
Contract(s)/Grant(s): NAG8-1342
Report No.(s): UAH-5-34744; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The University of Alabama in Huntsville contributes to the Technical Management of the Midcourse Space Experiment Program, to the Certification of the Level 2 data produced by the Midcourse Space Experiment's suite of in-orbit imaging radiometers, imaging spectro-radiometers and an interferometer and to the Transfer of the Midcourse Space Experiment Technology to other Government Programs. The Technical Management of the Midcourse Space Experiment Program is expected to continue through out the spacecraft's useful life time. The Transfer of Midcourse Space Experiment Technology to other government elements is expected to be on a demand basis by the USA Government and other organizations. The University, of Alabama Huntsville' contribution specifically supports the Principal Investigator's Executive Committee, the Deputy Principal Investigator for Data Certification and Technology Transfer team, the nine Ultraviolet Visible Imagers and Spectrographic Imagers (UVISI) and the Pointing and Alignment of all eleven of the science instruments. The science instruments effectively cover the 0.1 to 28 micron spectral region. The Midcourse Space Experiment spacecraft, launched April 24, 1996, is expected to have a 5 year useful lifetime. The cryogenically cooled IR sensor, SPIRIT III, performed through February, 1997 when its cryogen expired. A pre-launch, ground based calibration of the instruments provided a basis for the pre-launch certification of the Level 2 data base these instruments produce. With the spacecraft in-orbit the certification of the instrument's Level 2 data base was extended to the in-orbit environment.
Author
Spaceborne Experiments; Technology Transfer; Certification; Data Bases

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ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

19990028345 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Progenitor of the New COMPTEL/ROSAT Supernova Remnant in Vela
Chen, Wan, NASA Goddard Space Flight Center, USA; Gehrels, Neil, NASA Goddard Space Flight Center, USA; Astrophysical Journal; Apr. 01, 1999; Volume 514, pp. 1-4; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We show that (1) the newly discovered supernova remnant (SNR) GROJ0852-4642/RXJ0852.0-4622 was created by a core-collapse supernova of a massive star and (2) the same supernova event that produced the Ti-44 detected by COMPTEL from this source is probably also responsible for a large fraction of the observed Al-26 emission in the Vela region detected by the same instrument. The first conclusion is based on the fact that the remnant is currently expanding too slowly given its young age for it to be caused by a Type la supernova. If the current SNR shell expansion speed is greater than 3000 km/s, a 15 solar mass. Type II supernova with a moderate kinetic energy exploding at about 150 pc away is favored. If the SNR expansion speed is lower than 2000 km/s, as derived naively from X-ray data, a much more energetic supernova is required to have occurred at approximately 250 pc away in a dense environment at the edge of the Gum Nebula. This progenitor has a preferred ejecta mass of less than or equal to 10(Solar Mass), and therefore it is probably a Type Ib or Type Ic supernova. However, the required high ambient density of n(sub H) greater than or equal to 100 cu cm in this scenario is difficult to reconcile with the regional CO data. A combination

of our estimates of the age/energetics of the new SNR and the almost perfect positional coincidence of the new SNR with the centroid of the COMPTEL Al-26 emission feature of the Vela region strongly favors a causal connection. If confirmed, this will be the first case in which both Ti-44 and Al-26 are detected from the same young SNR, and together they can be used to select preferred theoretical core-collapse supernova models.
Author
Supernova Remnants; Gum Nebula; Stellar Mass; ROSAT Mission; Supernovae

19990028504 Boston Univ., Astronomy Dept., Boston, MA USA
ISO Observations of Starless Bok Globules: Usually No Embedded Stars
Clemens, D., Boston Univ., USA; Byrne, A., Boston Univ., USA; Yun, J., Lisbon Univ., Portugal; Kane, B., Phillips Lab., USA; [1996]; 4p; In English
Contract(s)/Grant(s): NAG5-3337; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have used ISOCAM to search the cores of a sample of small Bok globules previously classified to be mostly starless based on analysis of IRAS data. The ISO observations at 6.75microns (LW2 filter) and 14.5microns (LW3 filter) were sufficiently deep to enable detection of any low-mass hydrogen burning star or young stellar object (YSO) embedded in these globules. of the 20 Bok globules observed by ISOCAM to date, we have reduced the data for 14. of these, 13 show no evidence for faint red (S(sub v)(LW3) greater than S(sub v)(LW2)) stars missed by IRAS. One (CB68) does show the first mid-infrared detection of the very cool IRAS source toward this cloud, and may be a Class I or 0 YSO. We conclude, based on these new ISO observations, that Bok globules which have no IRAS sources are in general bona fide starless molecular clouds.
Author
Globules; Infrared Astronomy Satellite; Hydrogen; Infrared Space Observatory (ISO)

19990032024 Department of Energy, Office of Energy Research, Washington, DC USA
Observation of cosmological time dilation using type Ia supernovae as clocks
Goldhaber, G., Department of Energy, USA; Sep. 30, 1998; 10p; In English; Thermonuclear supernovae, USA; Sponsored by NATO Advanced Study Inst., Belgium
Report No.(s): DE98-059084; FNAL/C-98/277-A; CONF-9806116; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This work is based on the first results from a systematic search for high redshift Type Ia supernovae. Using filters in the R-band we discovered seven such SNe, with redshift z = 0.3-0.5, before or at maximum light. Type Ia SNe are known to be a homogeneous group of SNe, to first order, with very similar light curves, spectra and peak luminosities. In this talk we report that the light curves we observe are all broadened (time dilated) as expected from the expanding universe hypothesis. Small variations from the expected 1 + z broadening of the light curve widths can be attributed to a width-brightness correlation that has been observed for nearby SNe (z < 0.1). We show in this talk the first clear observation of the cosmological time dilation for macroscopic objects.
NTIS
Supernovae; Cosmology; Time Measurement; Red Shift; Clocks

19990032025 Department of Energy, Office of Energy Research, Washington, DC USA
Scheduled discoveries of 7+ high-Redshift supernovae: First cosmology results and bounds on q(sub 0)
Perlmutter, S., Department of Energy, USA; Sep. 30, 1998; 17p; In English; Thermonuclear supernovae, USA; Sponsored by NATO Advanced Study Inst., Belgium
Report No.(s): DE98-059083; FNAL/C-98/276-A; CONF-9806116; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Our search for high-redshift Type Ia supernovae discovered, in its first years, a sample of seven supernovae. Using a 'batch' search strategy, almost all were discovered before maximum light and were observed over the peak of their light curves. The spectra and light curves indicate that almost all were Type Ia supernovae at redshifts z = 0.35 - 0.5. These high-redshift supernovae can provide a distance indicator and 'standard clock' to study the cosmological parameters q(sub 0) , (Lambda), (Omega)(sub 0) , and H(sub 0). This presentation and the following presentations of Kim et al. (1996), Goldhaber et al. (1996), and Pain et al. (1996) will discuss observation strategies and rates, analysis and calibration issues, the sources of measurement uncertainty, and the cosmological implications, including bounds on q(sub 0) , of these first high-redshift supernovae from our ongoing search.
NTIS
Red Shift; Supernovae; Cosmology

19990032209 Colorado Univ., Joint Inst. of Lab. Astrophysics, Boulder, CO USA

Deuterium Abundance in the Local ISM and Possible Spatial Variations

Linsky, Jeffrey L., Colorado Univ., USA; Space Science Reviews; 1998; Volume 84, pp. 285-296; In English

Contract(s)/Grant(s): NASA Order S-56460-D; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Excellent HST/GHRS spectra of interstellar hydrogen and deuterium Lyman-(alpha) absorption toward nearby stars allow us to identify systematic errors that have plagued earlier work and to measure accurate values of the D/H ratio in local interstellar gas. Analysis of 12 sightlines through the Local Interstellar Cloud leads to a mean value of D/H = (1.50 +/- 0.10) x 10(exp -5) with all data points lying within +/- l(delta) of the mean. Whether or not the D/H ratio has different values elsewhere in the Galaxy and beyond is a very important open question that will be one of the major objectives of the Far Ultraviolet Spectroscopic Explorer (FUSE) mission.

Author

Deuterium; Interstellar Matter; Lyman Alpha Radiation; Interstellar Gas; Systematic Errors

19990032213 Colorado Univ., Joint Inst. of Lab. Astrophysics, Boulder, CO USA

A Critical Evaluation of Mass-Loss Rates and Wind Properties of Evolved Late-Type Stars

Linsky, Jeffrey L., Colorado Univ., USA; Harper, Graham M., Colorado Univ., USA; Bennett, Philip D., Colorado Univ., USA; Brown, Alex, Colorado Univ., USA; Valenti, Jeffrey, Colorado Univ., USA; 1997; 32p; In English; Cyclical Variability in Stellar Winds, 14-17 Oct. 1997, Garching, Germany; Sponsored by Electro-Optical Systems, Inc., USA

Contract(s)/Grant(s): GO-5323.01-93A; GO-06067.01-94A; NASA Order S-56460-D; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

We evaluate the accuracy with which the properties of late-type giant star winds can be estimated by fitting ultraviolet line profiles and radio continuum emission. Our test cases include the stars a TrA (K4 II), lambda Vel (K4 Ib-II), and zeta Aur (K4 Ib + B5 V). of particular interest is the sensitivity of the line profiles to the wind parameters M(dot)(sub 1) (sub infinity), v(sub turb), Beta, and T(sub wind). We are finding that while accurate and reliable values of M(dot) are difficult to obtain, the most reliable values come from the application of two or more independent techniques.

Author

Critical Mass; Late Stars; Stellar Evolution; Radio Emission; Losses

19990032287 Stanford Univ., Dept. of Physics, Stanford, CA USA

Relativistic Diskoseismology: Search for a Definitive Black Hole Signature

Wagoner, R. V., Stanford Univ., USA; Lehr, D. E., Stanford Univ., USA; Silbergleit, A. S., Stanford Univ., USA; Nowak, M. A., Colorado Univ., USA; Begelman, M. C., Colorado Univ., USA; 1997; 3p; In English; Sponsored in part by a NDSEG Fellowship

Contract(s)/Grant(s): NAS8-39225; NAG5-3102; NAG5-3225; NSF AST-95-29175; NSF AST-91-20599; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We will summarize some results of relativistic calculations of the eigenfunctions and eigenfrequencies of normal modes of oscillation trapped within the inner region of thin accretion disks by non-Newtonian gravitational properties of a black hole (or a compact, weakly-magnetized neutron star). The focus will be on the most observable, robust, and best-studied class: the analogue of (internal) gravity modes in stars. The frequency of the peak in the power spectrum of the luminosity modulations produced by the lowest modes is almost independent of the properties of the accretion disk. A feature with the required properties has recently been observed in at least one black hole candidate by the RXTE satellite, which produces a relation between the angular momentum and mass of the black hole.

Author

Accretion Disks; Black Holes (Astronomy); Signatures; Neutron Stars; Eigenvectors; Angular Momentum

19990032288 Colorado Univ., Joint Inst. of Lab. Astrophysics, Boulder, CO USA

Black Holes, Jets, and Accretion Disks

Begelman, Mitichell C., Colorado Univ., USA; 1997; 8p; In English

Contract(s)/Grant(s): NAGw-3838; NAG5-2026; NSF AST-91-20599; NSF AST-95-29175; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The prevailing paradigm for the energetic phenomena in active galactic nuclei and X-ray binaries, linking black holes, relativistic jets, and accretion disks, has been greatly strengthened in the last few years by a host of spectacular observational discoveries, plus a few theoretical developments. I briefly describe some of the most dramatic new results.

Author

Black Holes (Astronomy); Accretion Disks; X Ray Binaries

19990032412 Columbia Univ., Depts. of Astronomy and Physics, New York, NY USA

Search for Pulsations from a Nearby Millisecond Pulsar and Wasilewski 49: Mirror for a Hidden Seyfert 1 Nucleus ***Final Report, 1 Jul. 1997 - 30 Jun. 1998***

Halpern, Jules P., Columbia Univ., USA; March 1999; 21p; In English
Contract(s)/Grant(s): NAG5-4789
Report No.(s): CAL-3080; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Five studies are reported in this final report. The recently discovered 5.3 ms pulsar J1012+5307 at a distance of 520 pc is in an area of the sky which is particularly deficient in absorbing gas. The column density along the line of sight is less than 7.5 x 10(exp 19) CM(exp -2) which facilitates soft X-ray observations. Halpern reported a possible ROSAT Position Sensitive Proportional Counter (PSPC) detection of the pulsar in a serendipitous, off-axis observation. We have now confirmed the X-ray emission of PSR J1012+,5307 in a 23 ksec observation with the ROSAT High Resolution Imager (HRI). A point source is detected within 3" of the radio position. Its count rate of 1.6 +/- 0.3 x 10(exp -3) s(exp -1) corresponds to an unabsorbed 0. 1-2.4 keV flux of 6.4 x 10(exp -14) ergs cm(exp -2) s(exp -1), similar to that reported previously. This counts-to-flux conversion is valid for N(sub H) = 5 x 10(exp 19) cm(exp -2), and either a power-law spectrum of photon index 2.5 or a blackbody of kT = 0.1 keV. The implied X-ray luminosity of 2.0 x 10(exp 30) ergs s(exp -1) is 5 X 10(exp -4) of the pulsar's spin-down power dot-E, and similar to that of the nearest millisecond pulsar J0437-4715, which is nearly a twin of J1012+5307 in P dot-E. We subjected the 37 photons (and 13 background counts) within the source region to a pulsar search, but no evidence for pulsation was found. The pulsar apparently emits over a large fraction of its rotation cycle, and the absence of sharp modulation can be taken as evidence for surface thermal emission, as is favored for PSR J0437-4715, rather than magnetospheric X-ray emission which is apparent in the sharp pulses of the much more energetic millisecond pulsar B1821-24. A further test of this interpretation will be made with a longer ROSAT observation, which will increase the number of photons collected by a factor of 5, and permit a more sensitive examination of the light curve for modulation due to emission from heated polar caps. If found, such modulation will be further evidence that surface reheating by the impact of particles accelerated along open fiel;d lines operates in these approximately 10(exp -9) year old pulsars. In a second study, a new AM Her star serendipitously in a 25 day observation was detected with the EUVE satellite. A coherent period of 85.82 min is present in the EUVE Deep Survey imager light curve of this source. A spectroscopic optical identification is made with a 19th magnitude blue star that has H and He emission lines, and broad cyclotron humps typical of a magnetic cataclysmic variable. A lower limit to the polar magnetic field of 50 MG is estimated from the spacing of the cyclotron harmonics. EUVE J0425.6-5714 is also detected in archival ROSAT HRI observations spanning two months, and its stable and highly structured light curve permits us to fit a coherent ephemeris linking the ROSAT and EUVE data over a 1.3 yr gap. The derived period is 85.82107 +/- 0.00020 min, and the ephemeris should be accurate to 0.1 cycles until the year 2005. A narrow but partial X-ray eclipse suggests that this object belongs to the group of AM Her stars whose viewing geometry is such that the accretion stream periodically occults the soft X-ray emitting accretion spot on the surface of the white dwarf. A non-detection of hard X-rays from ASCA observations that are contemporaneous with the ROSAT HRI shows that the soft X-rays must dominate by at least an order of magnitude, which is consistent with a known trend among AM Her stars with large magnetic field. This object should not be confused with the Seyfert galaxy IH 0419-577 (= LB 1727), another X-ray/EUV source which lies only 3'95 away, and was the principal target of these monitoring observations. In a third report; the identity of the persistent high-energy (> 100 MeV) gamma-ray sources in the Galaxy, still largely a mystery is investigated. The second installment of the EGRET (2EG) lists a total of 128 sources, of which 51 are likely or possibly identified with AGNs, five with rotation-powered pulsars, and one is the LMC. There are 71 unidentified sources, of which 33, or almost half, lie in the narrow band of absolute value of b less than 10 degrees along the Galactic plane. This excess of low-latitude sources must, therefore, constitute a Galactic population that is either similar to the already identified gamma-ray pulsars, or an entirely new class of gamma-ray emitters associated with the disk population. We are continuing our program, begun in A06, that is aimed at intermediate-latitude sources, arguing that X-ray detection of them is the most plausible method of identifying the Galactic population. The sources at high latitude must statistically be mostly AGNS, and are more straightforwardly identified through radio and optical means. For the fourth report, identification of the EGRET Source the identity of the persistent, high-energy gamma-ray sources in the Galactic plane is a mystery. The most likely scenario is a population of middle-aged pulsars, many of which could be radio quiet like Geminga. We have an ongoing program of ROSAT, VLA, and optical observations of selected EGRET error circles at intermediate Galactic latitude. For one of these fields, at (l, b) = (106 degrees, +3), our complete census of X-ray and radio sources, reveals a remarkable association between a radio shell with unique properties, and a complete census of X-ray and radio sources reveals a remarkable association between a radio shell with unique properties, and a compact X-ray source. Further observations are needed to determine whether or not this source has a hard X-ray spectrum like that of other gamma ray pulsars and, ideally, to find its pulsations. A fifth report reviews,

Wasilewski 49, an interacting pair of Seyfert galaxies at z = 0.063, one of which contains a hidden Seyfert I nucleus as evidenced by broad wings on its Balmer lines.
Author
X Ray Astronomy; Ultraviolet Astronomy; Gamma Ray Astronomy; Cataclysmic Variables; X Ray Stars; Gamma Ray Sources (Astronomy); Active Galactic Nuclei; Pulsars; Seyfert Galaxies

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ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also 75 Plasma Physics.

19990028339 Department of Energy, Washington, DC USA
Effects of metallicity on (delta) Scuti star asteroseismology
Guzik, J. A., Department of Energy, USA; Bradley, P. A., Department of Energy, USA; Templeton, M. R., Department of Energy, USA; Mar. 31, 1998; 8p; In English; A half century of stellar pulsation interpretations - a tribute to Arthur N. Cox, USA
Report No.(s): DE98-004336; LA-UR-97-4910; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In (delta) Scuti star seismology, most researchers use evolution and pulsation models assuming a solar element mixture and Z = 0.02 for preliminary determinations of stellar masses or evolutionary state from observed frequencies. Here the authors investigate the consequences of this assumption by considering the effects of metallicity changes in the models on their inferences of the internal structure of (delta) Scuti stars. They use the main- sequence (delta) Scuti star FG Vir, and the more evolved shell hydrogen burning star (delta) Scuti to illustrate their results.
NTIS
Metallicity; Variable Stars; Stellar Models; Astronomy

19990028371 Department of Energy, Office of Energy Research, Washington, DC USA
Neutrino-driven supernovae: Boltzmann neutrino transport and the explosion mechanism
Messer, O. E., Department of Energy, USA; Mezzacappa, A., Department of Energy, USA; Guidry, M. W., Department of Energy, USA; Bruenn, S. W., Department of Energy, USA; Dec. 31, 1997; 10p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005656; ORNL/CP-98110; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Core-collapse supernovae are, despite their spectacular visual display, neutrino events. Virtually all (approximately 99%) of the 10(sup 53) power ergs of gravitational binding energy released in the formation of the nascent neutron star is carried away in the form of neutrinos and antineutrinos of all three flavors, and these neutrinos are primarily responsible for powering the explosion. This mechanism depends sensitively on the neutrino transport between the neutrinospheres and the shock. In light of this, the authors have performed a comparison of multigroup Boltzmann neutrino transport (MGBT) and (Bruenn's) multigroup flux-limited diffusion (MGFLD) in post-core bounce environments. Their analysis concentrates on those quantities central to the post-shock matter heating stemming from electron neutrino and antineutrino absorption, namely the neutrino luminosities, RMS energies, and mean inverse flux factors. The authors show that MGBT yields mean inverse flux factors in the gain region that are (approximately)25% larger and luminosities that are (approximately)10% larger than those computed by MGFLD. Differences in the mean inverse flux factors, luminosities, and RMS energies translate to heating rates that are up to 2 times larger for Boltzmann transport, with net cooling rates below the gain radius that are typically (approximately)0.8 times the MGFLD rates. These differences are greatest at earlier postbounce times for a given progenitor mass, and for a given postbounce time, greater for greater progenitor mass. The increased differences with increased progenitor mass suggest that the net heating enhancement from MGBT is potentially robust and self-regulated.
NTIS
Supernovae; Neutrinos; Boltzmann Transport Equation; Collapse; Planetary Cores; Neutron Stars

19990028492 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA
Transit of Extrasolar Planets *Final Report*
Doyle, Laurance R., Search for Extraterrestrial Intelligence Inst., USA; Jun. 16, 1998; 5p; In English
Contract(s)/Grant(s): NCC2-874; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

During the past five years we have pursued the detection of extrasolar planets by the photometric transit method, i.e. the detection of a planet by watching for a drop in the brightness of the light as it crosses in front of a star. The planetary orbit must cross

the line-of-sight and so most systems will not be lined up for such a transit to ever occur. However, we have looked at eclipsing binary systems which are already edge-on. Such systems must be very small in size as this makes the differential light change due to a transit much greater for a given planet size (the brightness difference will be proportional to the area of the transiting planet to the disc area of the star). Also, the planet forming region should be closer to the star as small stars are generally less luminous (that is, if the same thermal regime for planet formation applies as in the solar system). This led to studies of the habitable zone around other stars, as well. Finally, we discovered that our data could be used to detect giant planets without transits as we had been carefully timing the eclipses of the stars (using a GPS antenna for time) and this will drift by being offset by any giant planets orbiting around the system, as well. The best summary of our work may be to just summarize the 21 refereed papers produced during the time of this grant. This will be done is chronological order and in each section separately.
Author
Extrasolar Planets; Photometry; Line of Sight; Eclipsing Binary Stars; Gas Giant Planets; Solar System

19990028525 Department of Energy, Office of Energy Research, Washington, DC USA
Effects of general relativity on core collapse supernovae
DeNisco, K. R., Department of Energy, USA; Bruenn, S. W., Department of Energy, USA; Mezzacappa, A., Department of Energy, USA; Dec. 31, 1997; 8p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005657; ORNL/CP-98112; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effects of general relativity (GR) on the hydrodynamics and neutrino transport are examined during the critical shock reheating phase of core collapse supernovae. The authors find that core collapse computed with GR hydrodynamics results in a substantially more compact core structure out to the shock, the shock radius at stagnation being reduced by a factor of 2. The inflow speed of material behind the shock is also increased by a factor of 2 throughout most of the evolution. They have developed a code for general relativistic multigroup flux-limited diffusion (MGFLD) in static spacetimes and compared the steady-state neutrino distributions for selected time slices of post-bounce models with those computed with Newtonian MGFLD. The GR transport calculations show the expected reductions in neutrino luminosities and rms energies from redshift and curvature effects. Although the effects of GR on the hydrodynamics and neutrino transport seem to work against shock revival, the core configurations are sufficiently different that no firm conclusions can be drawn, except that simulations of core collapse supernovae using Newtonian hydrodynamics and transport are not realistic.
NTIS
Hydrodynamics; Neutrinos; Supernovae; Conferences; Stellar Physics; Models

19990028788 Department of Energy, Office of Energy Research, Washington, DC USA
Theoretical treatment of charge transfer processes of relevance to astrophysics
Krstic, P. S., Department of Energy, USA; Stancil, P. C., Department of Energy, USA; Schultz, D. R., Department of Energy, USA; Dec. 31, 1997; 7p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005055; ORNL/CP-97166; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Charge transfer is an important process in many astrophysical and atmospheric environments. While numerous experimental and theoretical studies exist for H and He targets, data on other targets, particularly metals and molecules, are sparse. Using a variety of theoretical methods and computational techniques the authors are developing methods to estimate the cross sections for electron capture (charge transfer) in slow collisions of low charge state ions with heavy (Mg, Ca, Fe, Co, Ni and Zn) neutrals. In this ongoing work particular attention is paid to ascertaining the importance of double electron capture.
NTIS
Astrophysics; Numerical Analysis; Charge Exchange; Charge Transfer; Charged Particles; Ion Atom Interactions

19990028835 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
New Solar System Population of WIMP Dark Matter
Damour, T., Institut des Hautes Etudes Scientifiques, France; Krauss, L. M., Case Western Reserve Univ., USA; Jun. 1998; 10p; In English
Report No.(s): PB99-122327; IHES/P/98/50; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The authors focus on the sub-population of WIMPs which scatter on a nucleus located near the surface of the Sun, and thereby loose just enough energy to stay in Earth-crossing orbits. These will be susceptible to small gravitational perturbations by the planets. The authors are interested then in the differential capture rate, per energy, and per angular momentum, of WIMPs in the Sun.
NTIS
Dark Matter; Gravitation; Solar System Evolution; Nuclear Fusion; Sun

19990028836 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Big Bang Nucleosynthesis and Tensor-Scalar Gravity
Damour, T., Institut des Hautes Etudes Scientifiques, France; Pichon, B., Observatoire de Paris-Meudon, France; Jul. 1998; 34p; In English
Report No.(s): PB99-122319; IHES/P/98/54; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Big Bang Nucleosynthesis (BNN) is studied within the framework of a two-parameter family of tensor-scalar theories of gravitation. The authors run a BBN code modified by tensor-scalar gravity, and impose that the theoretically predicted BBN yields of Deuterium, Helium and Lithium lie within some conservative observational ranges. It is found that large initial values of a(sub theta) (corresponding to initial cosmological expansion rates much larger than the standard) are compatible with observed BBN yields. However, BBN-inferred upper bound on the cosmological baryon density is insignificantly modified by considering tensor-scalar gravity.
NTIS
Big Bang Cosmology; Tensor Analysis; Nuclear Fusion; Gravitation

19990028839 Department of Energy, Office of Energy Research, Washington, DC USA
Molecule formation and destruction processes in astrophysical environments
Stancil, P. C., Department of Energy, USA; Dec. 31, 1997; 6p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005056; ORNL/CP-97162; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent quantum mechanical calculations of photodissociation and radiative association of some diatomic hydrides of potential astrophysical importance are presented. Enhancements to radiative association from stimulated emission due to a background radiation field and applications to the early universe, supernova ejecta, quasars, interstellar clouds and stellar atmospheres are discussed.
NTIS
Quantum Mechanics; Stellar Atmospheres; Molecules; Formations; Numerical Analysis; Molecular Clouds; Diatomic Molecules

19990028840 Department of Energy, Office of Energy Research, Washington, DC USA
Commissioning of the Daresbury Recoil Separator for nuclear astrophysics measurements at the Holifield Radioactive Ion Beam Facility
Smith, M. S., Department of Energy, USA; Blackmon, J. C., Department of Energy, USA; Koehler, P. E., Department of Energy, USA; Dec. 31, 1997; 10p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005057; ORNL/CP-97158; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Daresbury Recoil Separator (DRS) has been installed for nuclear astrophysics research at Oak Ridge National Laboratory's Holifield Radioactive Ion Beam Facility. it will be used for direct measurements of capture reactions on radioactive ions which occur in stellar explosions such as novae and X-ray bursts. The physics motivation and plans for the first measurements with radioactive beams are described, and details of the new DRS experimental equipment and preliminary results from the first commissioning experiments with stable beams are given.
NTIS
Bursts; Separators; Research Facilities; Linear Accelerators; Cosmic X Rays; Recoilings

19990031963 Columbia Univ., Depts. of Astronomy and Physics, New York, NY USA
Interpreting Broad Double-Peaked Emission Lines in Active Galactic Nuclei ***Final Report, 1 Mar. 1997 - 28 Feb. 1998***
Halpern, Jules, Columbia Univ., USA; Chen, Kaiyou, Columbia Univ., USA; March 1999; 3p; In English
Contract(s)/Grant(s): NAG5-3843
Report No.(s): CAL-3079; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The principal objectives of this project were to probe the inner regions of active galactic nuclei and to test general relativity in the strong-field limit. The approach takes advantage of broad atomic line emission observed from material deep in the potential well of an active galactic nucleus which contains key information as to the physics of the system. Line profiles in a wide range of wavebands from optical to X-ray have provided compelling evidence of the existence of a relativistic accretion disk around a supermassive black hole in a number of galaxies. The simplest model posits a geometrically thin disk in Keplerian orbit, with general relativistic effects in evidence. This model is the point of departure for the proposed work. We developed a high-performance numerical code to calculate photon trajectories in a Schwarzschild or Kerr metric and implemented it on parallel supercomputers. This code includes a general purpose ray tracer that calculates line profiles, light curves, and other observable quantities for a wide variety of emitter configurations. The versatility comes from the fact that the ray tracing algorithm does not depend on any symmetries regarding emitter locations. The speed comes from parallel implementation which enables us to sample hitherto unattainable volumes of disk model parameter space. During the period 1 March 1997 through 28 February 1998, two papers, supported in whole or in part by this grant, were published in refereed journals. They are reproduced in their entirety in the next two sections of this report.
Author
Active Galactic Nuclei; Accretion Disks; Relativistic Effects; Emission Spectra; Metric Space

19990032070 NASA Goddard Space Flight Center, Greenbelt, MD USA
On the Nature of the High Velocity(26) Al Near the Galactic Center
Sturner, Steven J., NASA Goddard Space Flight Center, USA; Naya, Juan E., NASA Goddard Space Flight Center, USA; Applied Physics Journal; 1998; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Recent observations of the Galactic Center region by the GRIS balloon-borne germanium spectrometer have determined that the diffuse 1809 keV emission resulting from the decay of Al-26 has an intrinsic width of 5.4 keV FWHM. This line width indicates that the Al-26 is either at a temperature of approximately 4.5 x 10(exp 8) K or it has a nonthermal velocity of approximately 500 km/s. Previous authors have suggested that the Al-26 must be trapped within dust grains in the ISM in order for these conditions to persist over the 10(exp 6) year lifetime of the aluminum (see e.g. Naya et al. 1996, Chen et al. 1998). We discuss the results of our model for the initial acceleration of the Al-26 in dust grains as they exit their source, Type II supernovae, and their subsequent reacceleration in the ISM by ambient supernova remnant (SNR) shocks. Our results show that dust grains can be maintained at a velocity sufficient to explain the GRIS observation for ISM densities of approximately 0.2 cu cm, dust grain sizes near 10(exp -5) cm, and distances between SNR shocks in the ISM of 100 - 200 pc.
Author
Supernova Remnants; Aluminum Isotopes; Spectral Line Width; Germanium; Supernovae

19990032369 Department of Energy, Office of Energy Research, Washington, DC USA
Bremsstrahlung and pair creation: Suppression mechanisms and how they affect EHE air showers
Klein, S. R., Department of Energy, USA; Dec. 31, 1997; 20p; In English
Report No.(s): DE98-052318; LBNL-41167; CONF-9711122; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Most calculations of air shower development have been based on the Bethe-Heitler cross sections for bremsstrahlung and pair production. However, for energetic enough particles, a number of different external factors can reduce these cross sections drastically, slowing shower development and lengthening the showers. Four mechanisms that can suppress bremsstrahlung and pair production cross sections are discussed, and their effect on extremely high energy air showers considered. Besides lengthening the showers, these mechanisms greatly increase the importance of fluctuations in shower development, and can increase the angular spreading of showers.
NTIS
Bremsstrahlung; Pair Production; Energetic Particles; Cosmic Ray Showers

91
LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

19990028347 NASA Goddard Space Flight Center, Greenbelt, MD USA
Ice-Associated Impact Craters on Mars: Implications from MOLA Observations
Garvin, J. B., NASA Goddard Space Flight Center, USA; Sakimoto, S. E. H., Universities Space Research Association, USA; 1998; In English; Lunar and Planetary Sciences, 15-18 Mar. 1998, Houston, TX, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Impact features adjacent to the permanent North Polar Cap on Mars provide a unique perspective on the crater formation and modification process. Little attention has been previously paid to the dozen's of ice-associated or 'frost-filled' craters north of 70N on Mars. We have examined Mars Orbiter Laser Altimeter (MOLA) cross-sections of 13 of these features between 7ON and 82N in an effort to understand cavity modification processes potentially associated with the advance and retreat of the North Polar ice cap. Here we treat the general geometric properties of these impact features and focus attention on one almost entirely filled example (i.e., 32 km diameter, located at 77N, 89E) for which high resolution Viking Orbiter images (50 m per pixel) provide key constraints for interpreting MOLA's meter-precision topographic measurements.
Derived from text
Ice; Cratering; Mars Craters; Mars Surface; Topography; Pixels

19990028348 NASA Goddard Space Flight Center, Greenbelt, MD USA
Climate-Rotation Feedback on Mars
Bils, Bruce G., NASA Goddard Space Flight Center, USA; 1998; In English; Lunar and Planetary Sciences, 15-18 Mar. 1998, Houston, TX, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

It has long been appreciated that changes in the orbital and rotational geometry of Mars will influence the seasonal and latitudinal pattern of insolation [1-5], and this will likely dominate climatic fluctuations on time scales of 101 to 107 years [6-9]. Equally important, but less widely appreciated, is the influence climatic change can have on rotational dynamics. The primary means by which climate influences rotation is via its influence on transport of mass (volatiles and dust) into and out of the polar regions. Both the rate and direction of Mars rotation can be changed by these mass fluxes, but only the directional changes are climatically relevant.
Derived from text
Climate Change; Mars (Planet); Mars Environment; Dust; Climatology

19990028624 NASA Goddard Space Flight Center, Greenbelt, MD USA
Topography of Impact Structures on the Northern Polar Cap of Mars
Sakimoto, S. E. H., Universities Space Research Association, USA; Garvin, J. B., NASA Goddard Space Flight Center, USA; 1998; In English; Lunar and Planetary Sciences, 15-18 Mar. 1998, Houston, TX, USA; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The north polar residual ice deposits of mars are thought to be relatively young, based on the reported lack of any fresh impact craters in Viking Orbiter images. A handful of possible impact features were identified, but available data were inconclusive. Determining the number and current topographic characteristics of any craters on the polar residual ice surface is important in constraining the surface age, relative importance of polar cap resurfacing processes and ice flow dynamics, and the role of the cap deposits in the global volatile and climate cycles. Subsequent image processing advances and new Mars Orbiter Laser Altimeter (MOLA) data in the north polar region are now a considerable aid in impact feature identification. This study reconsiders the abundant Viking high-resolution polar images along with the new altimetry data. We examine possible impact features, compare their topography with known mars high-latitude impact features, and use their morphology as a constraint on crater modification processes.
Derived from text
Topography; Mars Surface; Polar Caps; Ice; Climatology

19990028625 NASA Goddard Space Flight Center, Greenbelt, MD USA

Mid-Latitude versus Polar-Latitude Transitional Impact Craters: Geometric Properties from Mars Orbiter Laser Altimeter (MOLA) Observations and Viking Images

Matias, A., Puerto Rico Univ., Puerto Rico; Garvin, J. B., NASA Goddard Space Flight Center, USA; Sakimoto, S. E. H., Universities Space Research Association, USA; 1998; In English; Lunar and Planetary Sciences Conference, 15-18 Mar. 1998, Houston, TX, USA; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

One intriguing aspect of martian impact crater morphology is the change of crater cavity and ejecta characteristics from the mid-latitudes to the polar regions. This is thought to reflect differences in target properties such as an increasing presence of ice in the polar regions. Previous image-based efforts concerning martian crater morphology has documented some aspects of this, but has been hampered by the lack of adequate topography data. Recent Mars Orbiter Laser Altimeter (MOLA) topographic profiles provide a quantitative perspective for interpreting the detailed morphologies of martian crater cavities and ejecta morphology. This study is a preliminary effort to quantify the latitude-dependent differences in morphology with the goal of identifying target-dependent and crater modification effects from the combined of images and MOLA topography. We combine the available MOLA profiles and the corresponding Viking Mars Digital Image Mosaics (MDIMS), and high resolution Viking Orbiter images to focus on two transitional craters; one on the mid-latitudes, and one in the North Polar region. One MOLA pass (MGS Orbit 34) traverses the center of a 15.9 km diameter fresh complex crater located at 12.8degN 83.8degE on the Hesperian ridge plains unit (Hvr). Viking images, as well as MOLA data, show that this crater has well developed wall terraces and a central peak with 429 m of relative relief. Three MOLA passes have been acquired for a second impact crater, which is located at 69.5degN 41degE on the Vastitas Borealis Formation. This fresh rampart crater lacks terraces and central peak structures and it has a depth af 579 m. Correlation between images and MOLA topographic profiles allows us to construct basic facies maps of the craters. Eight main units were identified, four of which are common on both craters.

Derived from text

Latitude; Laser Altimeters; Mars Photographs; Image Analysis; Ejecta; Morphology; Mars Craters

19990032066 NASA Goddard Space Flight Center, Greenbelt, MD USA

Near-Polar Cratered Cones on Mars: Mola Measurements and Implications for Volcanic Origins

Garvin, J. B., NASA Goddard Space Flight Center, USA; Sakimoto, S. E. H., Universities Space Research Association, USA; 1999; In English; Lunar and Planetary Sciences, 15-18 Mar. 1999, Houston, TX, USA; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Near-polar craterforms have been observed on Mars since Mariner 9. Hodges and Moore [1,2] described the implications of these apparently volcanic features and suggested that several were formed as a consequence of magma-ice or magma-water interactions. Indeed, they proposed that the feature illustrated in Fig. I represents a hydromagmatic explosion crater or maar, indicating interaction of ground-ice and/or water with magma in the higher Northern hemisphere latitudes of Mars. The advent of Mars Orbiter Laser Altimeter (MOLA) topographic information 161 for several of the putative volcanic craterforms described in [1,2] allows a reconsideration of their formation mechanisms. We have exploited MOLA's near-centerline cross-sections from the Science Phasing Orbit phase of the Mars Global Surveyor (MGS) mission to analyze the geometric properties of these features as constraints on their modes of origin and subsequent modification histories. From our preliminary analyses, we believe there is evidence these features may have been formed by effusive, lava shield building eruptions, and not hydromagmatic events. Furthermore, geometrical constraints indicate that some of the near-polar craterforms are geologically youthful.

Author

Magma; Craters; Volcanoes; Mariner Spacecraft; Topography

19990032216 Washington Univ., Dept. of Earth and Planetary Sciences, Saint Louis, MO USA

Geology of Lunar Landing Sites and Origin of Basin Ejecta from a Clementine Perspective ***Final Report, 1 Jan. 1996 - 30 Jun. 1998***

Jolliff, Bradley L., Washington Univ., USA; Haskin, Larry A., Washington Univ., USA; 1998; 5p; In English

Contract(s)/Grant(s): NAGw-4906

Report No.(s): Rept-1041-59158; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The goals of this research were to examine Clementine multispectral data covering the Apollo landing sites in order to: (1) provide ground truth for the remotely sensed observations, (2) extend our understanding of the Apollo landing sites to the surrounding regions using the empirically calibrated Clementine data, and (3) investigate the composition and distribution of impact-basin ejecta using constraints based upon the remotely sensed data and the Apollo samples. Our initial efforts (in collaboration with P. Lucey and coworkers) to use the Apollo soil compositions to "calibrate" information derived from the remotely sensed data resulted in two extremely useful algorithms for computing estimates of the concentrations of FeO and TiO2 from the UV-VIS

5-band data. In this effort, we used the average surface soil compositions from 37 individual Apollo and 3 Luna sample stations that could be resolved using the Clementine data. We followed this work with a detailed investigation of the Apollo 17 landing site, where the sampling traverses were extensive and the spectral and compositional contrast between different soils covers a wide range. We have begun to investigate the nature and composition of basin ejecta by comparing the thick deposits on the rim of Imbrium in the vicinity of the Apollo 15 site and those occurring southeast of the Serenitatis basin, in the Apollo 17 region. We continue this work under NAG5-6784, "Composition, Lithology, and Heterogeneity of the lunar crust using remote sensing of impact-basin uplift structures and ejecta as probes. The main results of our work are given in the following brief summaries of major tasks. Detailed accounts of these results are given in the attached papers, manuscripts, and extended abstracts.
Derived from text
Geology; Lunar Landing Sites; Ejecta; Clementine Spacecraft; Research; Spectra; Remote Sensing; Lunar Crust

19990032552 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Lunar South Pole space water extraction and trucking system
Zuppero, A., Department of Energy, USA; Zupp, G., Department of Energy, USA; Schnitzler, B., Department of Energy, USA; Larson, T. K., Department of Energy, USA; Rice, J. W., Department of Energy, USA; Mar. 31, 1998; 12p; In English; Engineering, construction, and operations in space, 1998, USA
Report No.(s): DE98-052246; INEEL/CON-98-00163; CONF-980411; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This concept proposes to use thermal processes alone to extract water from the lunar South Pole and launch payloads to low lunar orbit. Thermal steam rockets would use water propellant for space transportation. The estimated mass of a space water tanker powered by a nuclear heated steam rocket suggests it can be designed for launch in the Space Shuttle bay. The performance depends on the feasibility of a nuclear reactor rocket engine producing steam at 1,100 degrees Kelvin, with a power density of 150 Megawatts per ton of rocket, and operating for thousands of 20 minute cycles. An example uses reject heat from a small nuclear electric power supply to melt 17,800 tons per year of lunar ice. A nuclear heated steam rocket would use the propellant water to launch and deliver 3,800 tons of water per year to a 100 km low lunar orbit.
NTIS
Space Transportation; Water; Extraction; Lunar Orbits; Melting; Trucks

92
SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.

19990028381 Department of Energy, Office of Energy Research, Washington, DC USA
Nuclear physics input for solar models
Csoto, A., Department of Energy, USA; Mar. 31, 1998; 12p; In English; 17th; Innovative computational methods in nuclear many-body problems, USA
Report No.(s): DE98-004365; LA-UR-97-4993; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors discuss microscopic cluster model descriptions of two solar nuclear reactions, (7)Be(p,(gamma))B-8, and He-3(He-3, 2p)He-4. The low-energy reaction cross section of (7)Be(p,(gamma))B-8, which determines the high-energy solar neutrino flux, is constrained by Be-7 and Be-8 observables. The results show that a small value of the zero-energy cross section is rather unlikely. In He-3(He-3, 2p)He-4 the authors study the effects of a possible virtual state on the cross section. Although, they have found no indication for such a state so far, its existence cannot be ruled out yet. They calculated the He-3, 2p)He-4 and H-3(H-3, 2n)He-4 cross sections in a continuum-discretized coupled channel approximation, and found a good general agreement with the data.
NTIS
Nuclear Physics; Nuclear Reactions

19990032186 NASA Goddard Space Flight Center, Greenbelt, MD USA
Particle Acceleration at the Sun and in the Heliosphere
Reames, Donald V., NASA Goddard Space Flight Center, USA; 1999; 78p; In English; No Copyright; Avail: CASI; A05, Hard-copy; A01, Microfiche

Energetic particles are accelerated in rich profusion at sites throughout the heliosphere. They come from solar flares in the low corona, from shock waves driven outward by coronal mass ejections (CMEs), from planetary magnetospheres and bow

shocks. They come from corotating interaction regions (CIRs) produced by high-speed streams in the solar wind, and from the heliospheric termination shock at the outer edge of the heliospheric cavity. We sample all these populations near Earth, but can distinguish them readily by their element and isotope abundances, ionization states, energy spectra, angular distributions and time behavior. Remote spacecraft have probed the spatial distributions of the particles and examined new sources in situ. Most acceleration sources can be ”seen” only by direct observation of the particles; few photons are produced at these sites. Wave-particle interactions are an essential feature in acceleration sources and, for shock acceleration, new evidence of energetic-proton-generated waves has come from abundance variations and from local cross-field scattering. Element abundances often tell us the physics the source plasma itself, prior to acceleration. by comparing different populations, we learn more about the sources, and about the physics of acceleration and transport, than we can possibly learn from one source alone.
Author
Particle Acceleration; Heliosphere; Sun; Energetic Particles; Solar Flares; Planetary Magnetospheres; Coronas; Wave-Particle Interactions

19990032214 Colorado Univ., Joint Inst. of Lab. Astrophysics, Boulder, CO USA
Helioseismic Constraints on New Solar Models from the MoSEC Code
Elliott, J. R., Colorado Univ., USA; Astronomy and Astrophysics; 1998; Volume 334, pp. 703-712; In English
Contract(s)/Grant(s): NAG5-2256; NAG5-3077; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

Evolutionary solar models are computed using a new stellar evolution code, MOSEC (Modular Stellar Evolution Code). This code has been designed with carefully controlled truncation errors in order to achieve a precision which reflects the increasingly accurate determination of solar interior structure by helioseismology. A series of models is constructed to investigate the effects of the choice of equation of state (OPAL or MHD-E, the latter being a version of the MHD equation of state recalculated by the author), the inclusion of helium and heavy-element settling and diffusion, and the inclusion of a simple model of mixing associated with the solar tachocline. The neutrino flux predictions are discussed, while the sound speed of the computed models is compared to that of the sun via the latest inversion of SOI-NMI p-mode frequency data. The comparison between models calculated with the OPAL and MHD-E equations of state is particularly interesting because the MHD-E equation of state includes relativistic effects for the electrons, whereas neither MHD nor OPAL do. This has a significant effect on the sound speed of the computed model, worsening the agreement with the solar sound speed. Using the OPAL equation of state and including the settling and diffusion of helium and heavy elements produces agreement in sound speed with the helioseismic results to within about +.-0.2%; the inclusion of mixing slightly improves the agreement.
Author
Magnetohydrodynamics; Relativistic Effects; Helioseismology; Sun; Solar Interior

19990032583 Colorado Univ., Boulder, CO USA
The Solar-Stellar Connection (NAG5-6124: SOHO Guest Investigator Program) ***Final Report***
Ayres, Thomas R., Colorado Univ., USA; 1997; 3p; In English
Contract(s)/Grant(s): NAG5-6124; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The following is a final report from the SOHO Guest Investigator program to use the SUMER far-UV spectrometer to obtain imaging spectroscopy in support of the goals of the so-called ”solar-stellar connection.” In particular, a major emphasis was utilization of the long-slit time-resolved maps of the solar surface in bright far-UV emission lines to deduce how particular aspects of the temporally and spatially averaged line profiles trace back to individual structural features of the magnetically disturbed outer atmosphere; to help interpret the unresolved line profiles from high quality stellar observations (say, with the Space Telescope Imaging Spectrograph). The researchers served two tours of duty in the SOHO Operations Center as SUMER planners, during which time we conducted an extensive series of observing programs. These can be divided into three general categories: surface mapping, translimb spectroscopy, and active region diagnostics. We have analyzed some of the large volumes of data to the point where we have presented them in poster papers, and in invited papers at national and international meetings. Listed below are the titles of the preliminary publications we have written, including brief abstracts to indicate the main results. (1) Chromospheric structure and Dynamics-- Observations -- The chromosphere is a highly structured dynamic ’layer’ of the solar outer atmosphere. Here, not only are the effects of mechanical heating first evident (moving upward in altitude from the deep photosphere), but also the amount of nonradiative energy deposited is far greater than in the albeit much hotter overlying transition region and corona. Further, the chromosphere is by far the thickest zone of the solar atmosphere with respect to the pressure scale height. A major goal of stellar astrophysics is to understand how the chromosphere is heated and why it adopts its peculiar structure. A cursory examination of solar filtergrams and high-resolution movies demonstrates that much of the chromospheric ”action” must be occurring on fine spatial scales and short times; particularly in the cell interior transient brightenings, but also in the longer-lived network fragments. That regime of investigation is far removed from what one usually associates with ”synoptic” measurements.

Nevertheless, synoptic observations of chromospheric indices, filtergrams, and globally-averaged profile parameters not only can provide important insight concerning the crucial role of the cycle-variable part of the solar magnetic field; but they also can forge a key link with analogous measurements of the stars, where often the phenomena can be significantly exaggerated from the solar case, but high spatial resolution reconnaissance is not even a remote possibility. In addition to discussing the synoptic aspects of chromospheric structure and dynamics, I summarized new insights into the general problem of the solar chromosphere that have been obtained recently with the SUMER far-ultraviolet spectrometer on SOHO. (2) CO and the Temperature Structure of the Solar Atmosphere -- The surface layers of the Sun provide a crucial boundary condition for many of the processes that occur in the deep interior. The stratification of the outer solar atmosphere once was thought to be well understood. However, studies of thermally sensitive molecular absorptions in the infrared revealed puzzling anomalies. Strong lines of the CO fundamental vibration-rotation bands near 5 microns showed very cool temperatures at the extreme limb, and remarkable off-limb emissions extending well into the supposedly hot chromosphere. The conflicting pictures of the photosphere/chromosphere interface, from the widely separated wavelength regimes, has raised suspicions that those ”layers” of the atmosphere are much more inhomogeneous than previously suspected. One proposal is that the low chromosphere is dominated by cool gas, the ”COmosphere,” which is threaded by a network of persistent small-scale hot magnetic filaments and occasionally disrupted by localized acoustic disturbances. The COmosphere is capped by the merged fields of the network elements in the chromospheric ”canopy.” (3) Translimb Spectroscopy with SOHO/SUMER -- We have used SUMER to obtain deep exposures of the 1300-1400 A spectrum, at the extreme limb and off-limb. Previous ”translimb” studies in the thermal infrared had revealed remarkable extensions of cold material (T is approximately equal to 3000 K)-traced by carbon monoxide emission lines-into the heart of the hot chromosphere. A main objective of our program was to search for corresponding far-UV signatures of the ”thermally-bifurcated” low chromosphere; for example, radiatively fluoresced emissions of the CO A-X 4th-positive system (collisional excitation would be negligible in cold gas). We conducted two separate observing programs with SUMER. Both made use of the 1 inch-diameter circular aperture, translated across the limb in the minimum motor step increments of 0.”375, along the central meridian in the Northern polar coronal hole. The first program executed for nine hours beginning 19UT 25 Oct 1996. The full wavelength range was 1340-1400 A. It was recorded in two overlapping segments, placing key regions of the spectrum alternately on the KBr and bare parts of the detector, to help isolate 2nd-order features. Each segment was integrated for 500 s, and 32 pairs were obtained to span a 12” swath centered on the optical limb. The second program was conducted 00-09UT 01 Dec 1996. It consisted of a single wavelength setting (1300-1340 A) with exposure time 500 s, but twice the spatial coverage of the earlier series: 64 steps, for a total displacement of 24”. The strong chromospheric resonance lines of atomic oxygen (1302-1305 A) and ionized carbon (1334-1335 A) were observed on the bare part of the MCP camera.
Author
Ultraviolet Astronomy; Chromosphere; Coronal Holes; Infrared Radiation; Solar Atmosphere; Solar Magnetic Field; Ultraviolet Radiation; Ionospheric Storms; Solar Corona; Stellar Structure; Solar Limb

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SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see 52 Aerospace Medicine. For theory see 73 Nuclear and High-Energy Physics.

19990028407 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Effects of coronal mass ejection on galactic cosmic rays in the high latitude heliosphere: Observations from Ulysses' first orbit
Bothmer, V., Department of Energy, USA; Heber, B., Department of Energy, USA; Kunow, H., Department of Energy, USA; Mueller-Mellin, R., Department of Energy, USA; Wibberenz, G., Department of Energy, USA; Oct. 31, 1997; 7p; In English; 25th; Cosmic Ray, USA
Report No.(s): DE98-000817; LA-UR-97-2669; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

During its first solar orbit, the Ulysses spacecraft detected several coronal mass ejections (CMEs) at high heliographic latitudes. The authors present first observations on the effects of these high latitude CMEs on galactic cosmic rays (GCRs) using measurements from the Kiel Electron Telescope (KET) which is part of the Cosmic Ray and Solar Particle Investigation (COSPIN) experiment, the Los Alamos SWOOPS (Solar Wind Observations Over the Poles of the Sun) experiment and the magnetic field experiments. They find the passage of these CMEs over the spacecraft to be associated with short term decreases of GCR intensities The relatively weak shocks in these events, driven by the CMEs' over-expansion, had no strong influence on the GCRs. The intensity minimums of GCRs occurred on closed magnetic field lines inside the CMEs themselves as indicated by bidirectional fluxes of suprathermal electrons. Short episodes of intensity increases of GCRs inside CMEs at times when the bidirectional

fluxes of suprathermal electrons disappeared, can be interpreted as evidence that GCRs can easily access the interior of those CMEs in which open magnetic field lines are embedded.
NTIS
Solar Corona; Solar Wind; Galactic Cosmic Rays; Stellar Mass Ejection; Magnetic Fields; Coronal Mass Ejection; Cosmic Rays

19990028425 NASA Goddard Space Flight Center, Greenbelt, MD USA
Intergalactic Extinction of High Energy Gamma-Rays
Stecker, F. W., NASA Goddard Space Flight Center, USA; Dec. 16, 1998; 18p; In English; TeV Astrophysics of Extragalactic Sources, Oct. 1998, Cambridge, UK; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We discuss the determination of the intergalactic pair-production absorption coefficient as derived by Stecker and De Jager by making use of a new empirically based calculation of the spectral energy distribution of the intergalactic infrared radiation field as given by Malkan and Stecker. We show that the results of the Malkan and Stecker calculation agree well with recent data on the infrared background. We then show that Whipple observations of the flaring gamma-ray spectrum of Mrk 421 hint at extragalactic absorption and that the HEGRA observations of the flaring spectrum of Mrk 501 appear to strongly indicate extragalactic absorption. We also discuss the determination of the y-ray opacity at higher redshifts, following the treatment of Salamon and Stecker. We give a predicted spectrum, with absorption included for PKS 2155-304. This XBL lies at a redshift of 0.12, the highest redshift source yet observed at an energy above 0.3 TeV. This source should have its spectrum steepened by approx. 1 in its spectral index between approx. 0.3 and approx. 3 TeV and should show an absorption cutoff above approx. 6 TeV.
Author
Gamma Rays; Spectral Energy Distribution; Numerical Analysis; Radiation Distribution; Intergalactic Media

19990028841 Department of Energy, Office of Energy Research, Washington, DC USA
Grey (gamma)-ray transfer procedure for supernovae
Jeffery, D. J., Department of Energy, USA; Dec. 31, 1997; 7p; In English; 2nd; Atomic and Nuclear Astrophysics, USA
Report No.(s): DE98-005058; ORNL/CP-97169; CONF-971208; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The (gamma)-ray transfer in supernovae for the purposes of energy deposition in the ejecta can be approximated as grey radiative transfer using mean opacities. In past work there is a single pure absorption mean opacity which is a free parameter. Accurate results can be obtained by varying this mean opacity to fit the results of more accurate procedures. In this paper, the authors present a grey (gamma)-ray transfer procedure for energy deposition in which there are multiple mean opacities that are not free parameters and that have both absorption and scattering components. This procedure is based on a local-state (LS) approximation, and so they call it the LS grey (gamma)-ray transfer procedure or LS procedure for short.
NTIS
Energy Absorption; Radiative Transfer; Gamma Rays; Energy Transfer

19990031968 NASA Johnson Space Center, Houston, TX USA
Advanced Cosmic Ray Composition Experiment for Space Station (ACCESS) ***Final Report***
Wilson, Thomas L., NASA Johnson Space Center, USA; Wefel, John P., Louisiana State Univ., USA; Jan. 31, 1999; 188p; In English
Contract(s)/Grant(s): NAG5-3770; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

In 1994 the first high-energy particle physics experiment for the Space Station, the Alpha Magnetic Spectrometer (AMS), was selected by NASA's Administrator as a joint collaboration with the U.S. Department of Energy (DOE). The AMS program was chartered to place a magnetic spectrometer in Earth orbit and search for cosmic antimatter. A natural consequence of this decision was that NASA would begin to explore cost-effective ways through which the design and implementation of AMS might benefit other promising payload experiments which were evolving from the Office of Space Science. The first such experiment to come forward was ACCESS in 1996. It was proposed as a new mission concept in space physics to place a cosmic-ray experiment of weight, volume, and geometry similar to the AMS on the ISS, and replace the latter as its successor when the AMS is returned to Earth. This was to be an extension of NASA's sub-orbital balloon program, with balloon payloads serving as the precursor flights and heritage for ACCESS. The balloon programs have always been a cost-effective NASA resource since the particle physics instrumentation for balloon and space applications are directly related. The next step was to expand the process, pooling together expertise from various NASA centers and universities while opening up definition of the ACCESS science goals to the international community through the standard practice of peer-review. This process is still on-going and the Accommodation

Study presented here will discuss the baseline definition of ACCESS as we understand it today. Further detail on the history, scope, and background of the study is provided in Appendix A.
Author
International Space Station; Cosmic Rays; Radiation Detectors; Calorimeters; Space Station Payloads

19990032211 Colorado Univ., Joint Inst. of Lab. Astrophysics, Boulder, CO USA
Aspects of the Solar Tachocline
Elliott, J. R., Colorado Univ., USA; Astronomy and Astrophysics; 1997; Volume 327, pp. 1222-1229; In English
Contract(s)/Grant(s): NAG5-2256; NAG5-3077; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

The splitting of the frequencies of p-mode multiplets enables information to be gained about the internal rotation of the sun. Such data have revealed a transition at the base of the convection zone from differential rotation similar to that observed at the surface to almost solid-body rotation in the radiative interior. This transition region, known as the tachocline, has been found to be relatively narrow and centered below the base of the convection zone. In this paper, the evolution of the transition region is investigated numerically. Without a large anisotropic viscosity, the depth to which it would spread in one solar age, under the assumption of a constant prescribed differential rotation at the base of the convection zone, is found to be greater than its extent as inferred from helioseismology. In the second part of the paper a highly anisotropic turbulent viscosity with a large horizontal component, as suggested by Spiegel & Zahn (1992), is assumed. In this case, a steady tachocline is formed in which the advection of angular momentum balances the Reynolds stresses. The horizontal component of turbulent viscosity required to match the thickness of the tachocline to that obtained by helioseismology, is estimated to be 5 x 1O sq cm/s The transport of helium is studied in this case and is found to yield a sound-speed increase similar to that required by helioseismology.
Author
Rotation; Sun; Helioseismology; Oscillations; Angular Momentum; Rotating Bodies; Acoustic Velocity

19990032377 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Galactic model of GRBs
Colgate, S. A., Department of Energy, USA; Li, H., Department of Energy, USA; Sep. 30, 1997; 8p; In English; 4th; Huntsville gamma ray bursts, USA
Report No.(s): DE98-005284; LA-UR-98-13; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The galactic model of gamma ray bursts (GRBs) is based upon the observed production of soft gamma ray repeaters (SGRs) in the galaxy and the consequences of a reasonable model to explain them. In this view GRBs are the long term result of the burn-out conditions of the SGRs in this and in other galaxies. A delay of (approximately) 30 million years before GRBs are being actively produced can be understood as the time required for the ejected matter during the SGR phase to cool, condense, and form planetesimals that are eventually captured by the central neutron star. The amount of disk matter and the interaction between each GRB and the disk determine the rate of burst production and turn-off time of GRBs. The x-ray afterglow as well as optical emission is derived from x-ray fluorescence and ionization of previously ablated matter.
NTIS
Gamma Ray Bursts; Galaxies; Astronomical Models; Gamma Ray Astronomy

99
GENERAL

19990028343 Institut Rudjer Boskovic, Zagreb Yugoslavia
End of Century State of Science
Sep. 12, 1998; 56p; In English, 7-11 Sep. 1998, Brijuni, Croatia
Contract(s)/Grant(s): F61708-98-W-0008
Report No.(s): AD-A360544; EOARD-CSP-98-1008; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche; Abstracts Only; Abstracts Only

The Final Proceedings for ”End of the Century State of Science”, 7 September1998 - 11 September 1998. This is an interdisciplinary conference. Topics include Ultracold collisions, Early Universe Computer power, Complexity of biological systems, the ultimate constituents of matter, Molecules in Space, Atoms, molecules, clusters, solids and Radiation-matter interaction.
DTIC
Conferences; Quantum Theory; Chemical Reactions; Nuclear Physics

19990028622 NASA, Washington, DC USA

National Aeronautics and Space Administration: 1998 Accountability Report

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This Accountability Report summarizes NASA's program accomplishments and its stewardship over budget and financial resources. The report is the culmination of NASA's management process, which begins with mission definition and program planning, continues with formulation and justification of NASA's budgets for the President and Congress, and ends with NASA scientific and engineering program accomplishments. This report covers NASA's activities from October 1, 1997, through September 30, 1998, with discussion of some subsequent events.

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It seems appropriate that a vehicle be available which fosters the development of new ideas and technologies, promotes the early exploration and exploitation of creative and innovative concepts, and develops new findable R and D projects and programs if BNL is to carry out its primary mission and support the basic Department of Energy (DOE) activities. At Brookhaven National Laboratory (BNL), one such method is through its Laboratory Directed Research and Development Program. This discretionary research and development tool is critical in maintaining the scientific excellence and vitality of the Laboratory. Additionally, it is a means to stimulate the scientific community, fostering new science and technology ideas, which is the major factor in achieving and maintaining staff excellence and a means to address national needs within the overall mission of the DOE and BNL.

NTIS

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Subject Term Index

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