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Langley Research Center

Scientific and Technical
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NASA STI Program ... in Profile

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- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA Programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.

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- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.

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  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

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STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

STAR includes citations to Research & Development (R&D) results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

The NASA STI Program

The NASA Scientific and Technical Information (STI) Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces and disseminates both NASA's internal STI and world-wide STI. The results of 20th and 21st century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA Aeronautics and Space Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up to date NASA STI, visit the STI Program's website at http://www.sti.nasa.gov.

NASA STI Availability Information

NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at help@sti.nasa.gov. Others should visit the program at www.sti.nasa.gov. The 'search selected databases' button provides access to the NASA Technical Reports Server (TRS) – the publicly available contents of the NASA Aeronautics and Space Database.

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The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at http://www.ntis.gov.

The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal Depository Libraries http://www.access.gpo.gov/su_docs.

The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at http://www.uspto.gov/patft/.

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Subject Term Index

Personal Author Index

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01
AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics, see *categories 02 through 09*. For information related to space vehicles *see 12 Astronautics*.

20050192192 NASA Glenn Research Center, Cleveland, OH, USA

Integrated Supportability Analysis and Cost System Enhanced

Seigneur, Alban D.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In recent years, the NASA Glenn Research Center at Lewis Field had recognized the need for propulsion system designs that would not only enhance performance but improve reliability and reduce system life-cycle costs. To deal with these issues, Glenn, in cooperation with GE Aircraft Engines, created the Enhanced Integrated Supportability Analysis and Cost System (ISACS+). GE developed the ISACS computer code in the early 1990's to simulate operation and support for the U.S. Air Force F-16 engine program. In 1996, Glenn s Propulsion Systems Analysis Office (PSAO) obtained the software from GE and entered into a 3-year Space Act Agreement whereby GE provided consulting support and Glenn's PSAO directed and coordinated the enhancement of the software. Glenn contracted with Technology Support Corporation of Cary, North Carolina, to perform this task. Funding for the enhanced ISACS (ISACS+) was provided by NASA Headquarters' Office of Safety & Mission Assurance and Office of Aero-Space Technology through Glenn's Office of Safety and Assurance Technologies and PSAO, respectively. ISACS+, operating in the MS Windows NT/95 environment, enables analysts to model a fleet of military or commercial aircraft and engines to determine the effects of engine reliability, maintainability, and logistics support on system safety and life-cycle cost. The ISACS+ model will support trade studies during the various design phases and through the full-scale production and fielding of aircraft to help designers and engineers meet the specified mission requirements at a minimum life-cycle cost. For aircraft engines in the field, ISACS+ can help maintenance planners specify the most economical maintenance support infrastructure. This would include providing information on when to repair, buy, and store individual parts and forecasting such things as labor utilization, support equipment, and demand for consumables at each maintenance center for a fleet of aircraft.

Derived from text

Aircraft Maintenance; Logistics Management; Systems Integration; Computer Programs; Aircraft Reliability

02
AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans, and other elements of turbomachinery. For related information see also *34 Fluid Mechanics and Thermodynamics*.

20050192429 NASA Langley Research Center, Hampton, VA, USA

Computational Aerothermodynamic Assessment of Space Shuttle Orbiter Tile Damage: Open Cavities

Pulsonetti, Maria; Wood, William; [2005]; 18 pp.; In English; 38th AIAA Thermophysics Conference, 6-9 Jun. 2005, Toronto, Ontario, Canada

Contract(s)/Grant(s): 23-376-70-30-08

Report No.(s): AIAA Paper 2005-4679; No Copyright; Avail: CASI; A03, Hardcopy

Computational aerothermodynamic simulations of Orbiter windside tile damage in flight were performed in support of the Space Shuttle Return-to-Flight effort. The simulations were performed for both hypervelocity flight and low-enthalpy wind

tunnel conditions and contributed to the Return-to-Flight program by providing information to support a variety of damage scenario analyses. Computations at flight conditions were performed at or very near the peak heating trajectory point for multiple damage scenarios involving damage windside acreage reaction cured glass (RCG) coated silica tile(s). The cavities formed by the missing tile examined in this study were relatively short leading to flow features which indicated open cavity behavior. Results of the computations indicated elevated heating bump factor levels predicted for flight over the predictions for wind tunnel conditions. The peak heating bump factors, defined as the local heating to a reference value upstream of the cavity, on the cavity floor for flight simulation were 67% larger than the peak wind tunnel simulation value. On the downstream face of the cavity the flight simulation values were 60% larger than the wind tunnel simulation values. On the outer mold line (OML) downstream of the cavity, the flight values are about 20% larger than the wind tunnel simulation values. The higher heating bump factors observed in the flight simulations were due to the larger driving potential in terms of energy entering the cavity for the flight simulations. This is evidenced by the larger rate of increase in the total enthalpy through the boundary layer prior to the cavity for the flight simulation.
Author
Aerothermodynamics; Damage Assessment; Space Shuttle Orbiters; Aerodynamic Heating; Cavities; Tiles

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety* and *85 Technology Utilization and Surface Transportation*.

20050188518 NASA Lewis Research Center, Cleveland, OH, USA
National Transportation Safety Board Aircraft Accident Investigation Supported
Reehorst, Andrew L.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The main purpose of this investigation was for NASA to help the National Transportation Safety Board (NTSB) gain better understanding of the events that led to the loss of Comair Flight 3272 over Monroe, Michigan, on January 9, 1997. In-flight icing was suspected as being the primary cause of this accident. Of particular interest to the Safety Board was what NASA could learn about the potential performance degradation of the wing of the Embraer EMB-120 twin-turboprop commuter aircraft with various levels of ice contamination. NASA agreed to undertake (1) ice-accretion prediction computations with NASA s LEWICE program to bound the kind of contaminations that the vehicle may have developed, (2) testing in the NASA Lewis Research Center's Icing Research Tunnel to verify and refine the ice shapes developed by LEWICE, (3) a two-dimensional Navier- Stokes analysis to determine the performance degradation that those ice shapes could have caused, and (4) an examination using three-dimensional Navier-Stokes codes to study the three-dimensional effects of ice contamination.
Derived from text
Aircraft Accident Investigation; Aircraft Icing; Navier-Stokes Equation

20050189232 Animal and Plant Health Inspection Service, Washington, MD, USA
Traveling With Your Pet
Oct. 1998; 12 pp.; In English
Report No.(s): PB2005-107148; USDA/MPUB-1536; No Copyright; Avail: CASI; A03, Hardcopy

Dogs, cats, and most other warm-blooded animals transported in commerce are protected by the Animal Welfare Act (AWA). The U.S. Department of Agricultures (USDA) Animal and Plant Health Inspection Service (APHIS) enforces this law. APHIS shipping regulations help ensure that people who transport and handle animals covered under the AWA treat them humanely. Airlines and other shippers are affected by regulations established to protect the wellbeing of animals in transit.
NTIS
Animals; Health; Inspection; Regulations

20050192113 NASA Lewis Research Center, Cleveland, OH, USA
National Transportation Safety Board Aircraft Accident Investigation Supported
Reehorst, Andrew L.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The main purpose of this investigation was for NASA to help the National Transportation Safety Board (NTSB) gain better understanding of the events that led to the loss of Comair Flight 3272 over Monroe, Michigan, on January 9, 1997. In-flight icing was suspected as being the primary cause of this accident. Of particular interest to the Safety Board was what NASA could learn about the potential performance degradation of the wing of the Embraer EMB-120 twin-turboprop commuter aircraft with various levels of ice contamination.
Derived from text
Accident Investigation; Commuter Aircraft; Degradation; Ice Formation; Safety Management

20050192374 NASA Glenn Research Center, Cleveland, OH, USA
Ice Accretions on Modern Airfoils Investigated
Addy, Harold E., Jr.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Icing Branch at the NASA Glenn Research Center at Lewis Field initiated and conducted the Modern Airfoils Ice Accretions project to identify ice shapes and determine their effects on the aerodynamic performance of aircraft, particularly on lift and drag. Previous aircraft ice shape and performance documentation focused on a few, older airfoils. This permitted more basic studies of the ice accretion process to be undertaken. However, having established both a working data base of ice shapes and the capability to predict these shapes for basic airfoils, questions arose about how ice might accrete differently on airfoils more representative of those being designed and flown on various aircraft today. Similarly, information about how these ice shapes would affect aerodynamic performance was needed.
Derived from text
Airfoils; Aircraft Icing

20050192376 NASA Glenn Research Center, Cleveland, OH, USA, Federal Aviation Administration, USA, National Center for Atmospheric Research, Boulder, CO, USA, Atmospheric Environment Service, Canada
Supercooled Large Droplet Icing Flight Research Program
Miller, Dean R.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

During the past three winters, the NASA Glenn Research Center at Lewis Field conducted icing research flights throughout the Great Lakes region to measure the characteristics of a severe icing condition having Supercooled Large Droplets (SLD). SLD was implicated in the 1994 crash of the ATR-72 commuter aircraft. This accident focused attention on the safety hazard associated with SLD, and it led the Federal Aviation Administration (FAA) to identify the need for a better understanding of the atmospheric characteristics of this icing condition. In response to this need, Glenn developed a cooperative icing flight research program with the FAA, the National Center for Atmospheric Research, and the Atmospheric Environment Service of Canada. The primary objectives were to (1) characterize the SLD icing condition in terms of important icing-related parameters (such as cloud droplet size, cloud water content, and temperature), (2) develop and refine SLD icing weather forecast products, and (3) document and measure the effects of SLD ice accretions on aircraft performance.
Derived from text
Supercooling; Drops (Liquids); Aircraft Icing; Drop Size

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance*; and *39 Structural Mechanics*. For land transportation vehicles see *85 Technology Utilization and Surface Transportation*.

20050186898 Army Research Lab., Hampton, VA, USA
The Effect of Tip Geometry on Active-Twist Rotor Response
Wilbur, Matthew L.; Sekula, Martin K.; [2005]; 12 pp.; In English; American Helicopter Sociert 61st Annual Forum, 1-3 Jun. 2005, Grapevine, TX, USA
Contract(s)/Grant(s): 23-745-60-RB; Copyright; Avail: CASI; A03, Hardcopy

A parametric examination of the effect of tip geometry on active-twist rotor system response is conducted. Tip geometry parameters considered include sweep, taper, anhedral, nonlinear twist, and the associated radial initiation location for each of these variables. A detailed study of the individual effect of each parameter on active-twist response is presented, and an assessment offered of the effect of combining multiple tip shape parameters. Tip sweep is shown to have the greatest affect

on active-twist response, significantly decreasing the response available. Tip taper and anhedral are shown to increase moderately the active-twist response, while nonlinear twist is shown to have a minimal effect. A candidate tip shape that provides active-twist response equivalent to or greater than a rectangular planform blade is presented.
Author
Rectangular Planforms; Rotors; Nonlinearity; Position (Location)

20050188446 Defence Science and Technology Organisation, Fishermans Bend, Australia
Strain Survey of an F/A-18 Stabhtor Spindle Using High Density Bragg Grating Arrays
Davis, Claire; February 2005; 38 pp.; In English
Report No.(s): DSTO-TN-0615; DODA-AR-013-342; Copyright; Avail: Other Sources

A strain survey of the F/ A-18 stabilator spindle has recently been undertaken to calibrate a finite element model of the spindle. Whilst the strain measurements used for the finite element validation were made using conventional electrical resistance foil strip gauges, strain measurements were also carried out using co-located distributed optical-fibre Bragg-grating arrays. This report describes the design, fabrication and attachment of the distributed Bragg gratings and compares the strain response of the optical fibre sensors to the conventional electrical-resistance foil strain gauges during the static strain survey. The results demonstrate that the performance of the high-density distributed Bragg grating arrays compares favourably with electrical resistance foil strip gauges with the additional advantage of reducing strain gauge cabling weight, density and complexity, The response of the Bragg gratings to a dynamic loading regime of up to 1OOHz was also measured. Although excellent correlation between the two types of measurement techniques on a full scale structure were observed, further work is required to optimise the application technique for these gratings and to assess the reliability and durability of these sensors over time.
Author
F-18 Aircraft; Spindles; Strain Measurement; Bragg Gratings

20050188447 Defence Science and Technology Organisation, Fishermans Bend, Australia
A Review of Australian and New Zealand Investigations on Aeronautical Fatigue During the Period April 2003 to March 2005
Clark, Graham; May 2005; 86 pp.; In English; 29th Conference of the International Committee on Aeronautical Fatigue, 6-7 Jun. 2005, Hamburg, Germany
Report No.(s): DSTO-TN-0624; DODA-AR-013-387; Copyright; Avail: Other Sources

This document has been prepared for presentation to the 29th Conference of the International Committee on Aeronautical Fatigue scheduled to be held in Hamburg, Germany, 6th and 7th June 2005. Brief summaries and references are provided on the aircraft fatigue research and associated activities of research laboratories, universities, and aerospace companies in Australia and New Zealand during the period April 2003 to March 2005. The review covers fatigue-related research programs as well as fatigue investigations on specific military and civil aircraft.
Author
Military Aircraft; Aircraft Structures; Fatigue (Materials); Australia; New Zealand; Structural Analysis

20050188495 NASA Lewis Research Center, Cleveland, OH, USA
Acoustic Pyrometry Applied to Gas Turbines and Jet Engines
Fralick, Gustave C.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Internal gas temperature is one of the most fundamental parameters related to engine efficiency and emissions production. The most common methods for measuring gas temperature are physical probes, such as thermocouples and thermistors, and optical methods, such as Coherent Anti Stokes Raman Spectroscopy (CARS) or Rayleigh scattering. Probes are relatively easy to use, but they are intrusive, their output must be corrected for errors due to radiation and conduction, and their upper use temperature is limited. Optical methods are nonintrusive, and they measure some intrinsic property of the gas that is directly related to its temperature (e.g., lifetime or the ratio of line strengths). However, optical methods are usually difficult to use, and optical access is not always available. Lately, acoustic techniques have been receiving some interest as a way to overcome these limitations.
Derived from text
Combustion Products; Exhaust Gases; Gas Temperature; Raman Spectroscopy; Temperature Measurement; Sound Detecting and Ranging

20050188497 NASA Lewis Research Center, Cleveland, OH, USA

Pressure-Sensitive Paint Applied to Ice Accretions

Bencic, Timothy J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Aircraft icing occurs when a plane flies through a cloud of supercooled water droplets. When the droplets impinge on aircraft components, ice starts to form and accumulate. This accumulation of ice severely increases the drag and lift of the aircraft, and can ultimately lead to catastrophic failures and even loss of life. Knowledge of the air pressures on the surfaces of ice and models in wind tunnels allows researchers to better predict the effects that different icing conditions will have on the performance of real aircraft. The use of pressure-sensitive paint (PSP) has provided valuable information on similar problems in conventional wind tunnel testing. In NASA Lewis Research Center Icing Research Tunnel, Lewis researchers recently demonstrated the world s first application of PSP on actual ice formed on a wind tunnel model. This proof-of-concept test showed that a new paint formulation developed under a grant by the University of Washington adheres to both the ice shapes and cold aluminum models, provides a uniform coating that preserves the detailed ice shape structure, and responds to simulated pressure changes.

Derived from text

Aircraft Icing; Coating; Ice Formation; Losses; Pressure Sensitive Paints

20050188530 NASA Lewis Research Center, Cleveland, OH, USA

Three-Dimensional Gear Crack Propagation Studied

Lewicki, David G.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Gears used in current helicopters and turboprops are designed for light weight, high margins of safety, and high reliability. However, unexpected gear failures may occur even with adequate tooth design. To design an extremely safe system, the designer must ask and address the question, 'What happens when a failure occurs?' With gear-tooth bending fatigue, tooth or rim fractures may occur. A crack that propagates through a rim will be catastrophic, leading to disengagement of the rotor or propeller, loss of an aircraft, and possible fatalities. This failure mode should be avoided. A crack that propagates through a tooth may or may not be catastrophic, depending on the design and operating conditions. Also, early warning of this failure mode may be possible because of advances in modern diagnostic systems. One concept proposed to address bending fatigue fracture from a safety aspect is a splittooth gear design. The prime objective of this design would be to control crack propagation in a desired direction such that at least half of the tooth would remain operational should a bending failure occur. A study at the NASA Lewis Research Center analytically validated the crack-propagation failsafe characteristics of a split-tooth gear. It used a specially developed three-dimensional crack analysis program that was based on boundary element modeling and principles of linear elastic fracture mechanics. Crack shapes as well as the crack-propagation life were predicted on the basis of the calculated stress intensity factors, mixed-mode crack-propagation trajectory theories, and fatigue crack-growth theories. The preceding figures show the effect of the location of initial cracks on crack propagation. Initial cracks in the fillet of the teeth produced stress intensity factors of greater magnitude (and thus, greater crack growth rates) than those in the root or groove areas of the teeth. Crack growth was simulated in a case study to evaluate crack-propagation paths. Tooth fracture was predicted from the crackgrowth simulation for an initial crack in the tooth fillet region. This was the desired failure mode for an ultrasafe design. Lastly, tooth loads on the uncracked mesh of the split-tooth design were up to five times greater than those on the cracked mesh if equal deflections of the cracked and uncracked teeth were considered. This effect needs to be considered in the design of a split-tooth configuration. This work was done in-house at Lewis in support of the National Rotorcraft Technology Center project, Ultra-Safe Gear Design, with the Boeing Defense and Space Group. The crack-propagation package was developed by the Cornell Fracture Group at Cornell University. The reported results, which are the initial findings of Lewis gear-crackpropagation research for the Rotorcraft Base Program, will be further investigated to develop generalized gear design guidelines.

Author

Crack Propagation; Gear Teeth; Three Dimensional Models; Rotary Wing Aircraft

20050189221 Lawrence Livermore National Lab., Livermore, CA USA, McClellan AFB, CA, USA

Preprocessing of Backprojection Images in the McClellan Nuclear Radiation Center Tomography System

Gibbons, M. R.; Sheilds, K.; Feb. 19, 1998; 56 pp.; In English

Report No.(s): DE2005-16726; UCRL-ID-129965; No Copyright; Avail: Department of Energy Information Bridge

Neutron tomography is being investigated as a nondestructive technique for quantitative assessment of low atomic mass impurity concentration in metals. Neutrons maximize the sensitivity given their higher cross sections for low Z isotopes while

tomography provides the three dimensional density information. The specific application is the detection of Hydrogen down to 200 ppm weight in aircraft engine compressor blades. A number of preprocessing corrections have been implemented for the backprojection images in order to achieve the detection requirements for a testing rate of three blades per hour. Among the procedures are corrections for neutron scattering and beam hardening. With these procedures the artifacts in tomographic reconstructions are shown to be less than the signal for 100 ppm hydrogen in titanium alloy samples.
NTIS
Neutrons; Nuclear Radiation; Preprocessing; Tomography

20050192094 NASA Lewis Research Center, Cleveland, OH, USA
Microelectrical Mechanical Systems Flow Control Used to Manage Engine Face Distortion in Compact Inlet Systems
Anderson, Bernhard H.; Miller, Daniel N.; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Turbofan engine-face flow distortion is one of the most troublesome and least understood problems for designers of modern engine inlet systems. One concern is that there are numerous sources of flow-field distortion that are ingested by the inlet or generated within the inlet duct itself. Among these are: (1) flow separation at the cowl lip during in-flight maneuvering, (2) flow separation on the compression surfaces due to shock-wave/boundary layer interactions, (3) spillage of the fuselage boundary layer into the inlet duct, (4) ingestion of aircraft vortices and wakes emanating from upstream disturbances, and (5) strong secondary flow gradients and flow separation induced by wall curvature within the inlet duct itself. Most developing aircraft (including the B70, F-111, F-14, Mig-25, Tornado, and Airbus A300) have experienced one or more of these types of problems, particularly at high Mach numbers and/or extreme maneuver conditions when flow distortion at the engine face exceeded the allowable limits of the engine.
Derived from text
Boundary Layer Separation; Engine Inlets; Flow Distortion; Intake Systems

20050192165 NASA Glenn Research Center, Cleveland, OH, USA
TiAl Scramjet Inlet Flap Subelement Designed and Fabricated
Draper, Susan L.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Next-generation launch vehicles are being designed with turbine-based combined cycle (TBCC) propulsion systems having very aggressive thrust/weight targets and long lives. Achievement of these goals requires advanced materials in a wide spectrum of components. TiAl has been identified as a potential backstructure material for maintainable composite panel heat exchangers (HEX) in the inlet, combustor, and nozzle section of a TBCC propulsion system. Weight reduction is the primary objective of this technology. Design tradeoff studies have assessed that a TiAl structure, utilizing a high-strength, hightemperature TiAl alloy called Gamma MET PX,1 reduce weight by 41 to 48 percent in comparison to the baseline Inconel 718 configuration for the TBCC propulsion system inlet, combustor, and nozzle. A collaborative effort between the NASA Glenn Research Center, Pratt & Whitney, Engineering Evaluation & Design, PLANSEE AG (Austria), and the Austrian Space Agency was undertaken to design, manufacture, and validate a Gamma-MET PX TiAl structure for scramjet applications. The TiAl inlet flap was designed with segmented flaps to improve manufacturability, to better control thermal distortion and thermal stresses, and to allow for maintainable HEX segments. The design philosophy was to avoid excessively complicated shapes, to minimize the number of stress concentrations, to keep the part sizes reasonable to match processing capabilities, and to avoid risky processes such as welding. The conceptual design used a standard HEX approach with a double-pass coolant concept for centrally located manifolds. The flowpath side was actively cooled, and an insulation package was placed on the external side to save weight. The inlet flap was analyzed structurally, and local high-stress regions were addressed with local reinforcements.
Author
Supersonic Combustion Ramjet Engines; Titanium Aluminides; Supersonic Inlets; Engine Inlets; Flaps (Control Surfaces)

20050192219 NASA Glenn Research Center, Cleveland, OH, USA, Case Western Reserve Univ., Cleveland, OH, USA
System Being Developed to Measure the Rotordynamic Characteristics of Air Foil Bearings
Howard, Samuel A.; DellaCorte, Christopher; Valco, Mark J.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Because of the many possible advantages of oil-free engine operation, interest in using air lubricated foil-bearing technology in advanced oil-free engine concepts has recently increased. The Oil-Free Turbomachinery Program at the NASA Glenn Research Center at Lewis Field has partially driven this recent push for oil-free technology. The program's goal of

developing an innovative, practical, oil-free gas turbine engine for aeropropulsion began with the development of NASA's high-temperature solid-lubricant coating, PS304. This coating virtually eliminates the life-limiting wear that occurs during the startup and shutdown of the bearings. With practically unlimited life, foil air bearings are now very attractive to rotating machinery designers for use in turbomachinery. Unfortunately, the current knowledge base of these types of bearings is limited. In particular, the understanding of how these types of bearings contribute to the rotordynamic stability of turbomachinery is insufficient for designers to design with confidence. Recent work in oil-free turbomachinery has concentrated on advancing the understanding of foil bearings. A high-temperature fiber-optic displacement probe system and measurement method were developed to study the effects of speed, load, temperature, and other environmental issues on the stiffness characteristics of air foil bearings. Since high temperature data are to be collected in future testing, the testing method was intentionally simplified to minimize the need for expensive test hardware. The method measures the displacement induced upon a bearing in response to an applied perturbation load. The early results of these studies, which are shown in the accompanying figure, indicate trends in steady state stiffness that suggest stiffness increases with load and decreases with speed. It can be seen, even from these data, that stiffness is not expected to change by orders of magnitude over the normal operating range of most turbomachinery; a promising sign for their eventual integration into oil-free turbomachines. Planned future testing will generate similar plots for stiffness changes with temperature and geometry, as well as damping data. The data collected by this method represent a critical step toward understanding how to successfully apply foil air bearings to future oil-free turbomachinery systems.

Author

Foil Bearings; Rotor Dynamics; Engine Design; Systems Engineering; Technology Utilization

20050192274 NASA Glenn Research Center, Cleveland, OH, USA

Formation of Leading-Edge Pinholes in the Space Shuttle Wings Investigated

Jacobson, Nathan S.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The space shuttle wing leading edge and nose cap are composed of a carbon/carbon composite that is protected by silicon carbide. The coefficient of thermal expansion mismatch leads to cracks in the silicon carbide. The outer coating of the silicon carbide is a sodium-silicate-based glass that becomes fluid at the shuttles high reentry temperatures and fills these cracks. Small pinholes roughly 0.1 mm in diameter have been observed on these materials after 12 or more flights. These pinholes have been investigated by researchers at the NASA Johnson Space Center, Rockwell International, the Boeing Company, Lockheed Martin Corporation, and the NASA Glenn Research Center at Lewis Field to determine the possible sources and the extent of damage. A typical pinhole is illustrated in the photomicrographs. These pinholes are found primarily on the wing leading edges and not on the nose cap, which is covered when the orbiter is on the launch pad. The pinholes are generally associated with a bead of zincrich glass. Examination of the orbiter and launch structure indicates that weathering paint on the launch structure leads to deposits of zinc-containing paint flakes on the wing leading edge. These may become embedded in the crevices of the wing leading edge and form the observed zinc-rich glass. Laboratory experiments indicate that zinc oxide reacts vigorously with the glass coating on the silicon carbide. Thus, it is likely that this is the reaction that leads to pinhole formation (Christensen, S.V.: Reinforced Carbon/Carbon Pin Hole Formation Through Zinc Oxide Attack. Rockwell International Internal Letter, RDW 96 057, May 1996). Cross-sectional examination of pinholes suggests that they are enlarged thermal expansion mismatch cracks. This is illustrated in the photomicrographs. A careful microstructural analysis indicates that the pinhole walls consist of layers of zinc-containing glass. Thus, pinholes are likely formed by zinc oxide particles lodging in crevices and forming a corrosive zinc-rich glass that enlarges existing cracks. Having established the likely source of the pinholes, we next needed to model the damage. Our concern was that if a pinhole went through the silicon carbide to the carbon/carbon substrate, oxygen would have a clear path to oxidize the carbon at high temperatures. This possibility was examined with studies in a laboratory furnace. An ultrasonic drill was used to make artificial pinholes in a sample of protected carbon/carbon. After exposure, the specimens were weighed and cross-sectioned to quantify the extent of oxidation below the pinhole. The results at higher temperatures showed good agreement with a simple diffusion-control model. This model is based on the two-step oxidation of carbon to carbon monoxide and carbon dioxide. The fluxes are illustrated in the final figure. The model indicates a strong dependence on pinhole diameter. For smaller diameters and short times, the oxidation of carbon is very limited.

Author

Leading Edges; Pinholes; Space Shuttles; Wings; Silicon Carbides; Nose Cones

20050192276 NASA Glenn Research Center, Cleveland, OH, USA, Allied-Signal Corp., USA
Turbine Airfoil With CMC Leading-Edge Concept Tested Under Simulated Gas Turbine Conditions
Robinson, R. Craig; Hatton, Kenneth S.; Research and Technology 1999; March 2000; 3 pp.; In English
Contract(s)/Grant(s): N00014-96-C-0149; No Copyright; Avail: CASI; A01, Hardcopy

Silicon-based ceramics have been proposed as component materials for gas turbine engine hot-sections. When the Navy s Harrier fighter experienced engine (Pegasus F402) failure because of leading-edge durability problems on the second-stage high-pressure turbine vane, the Office of Naval Research came to the NASA Glenn Research Center at Lewis Field for test support in evaluating a concept for eliminating the vane-edge degradation. The High Pressure Burner Rig (HPBR) was selected for testing since it could provide temperature, pressure, velocity, and combustion gas compositions that closely simulate the engine environment. The study focused on equipping the stationary metal airfoil (Pegasus F402) with a ceramic matrix composite (CMC) leading-edge insert and evaluating the feasibility and benefits of such a configuration. The test exposed the component, with and without the CMC insert, to the harsh engine environment in an unloaded condition, with cooling to provide temperature relief to the metal blade underneath. The insert was made using an AlliedSignal Composites, Inc., enhanced HiNicalon (Nippon Carbon Co. LTD., Yokohama, Japan) fiber-reinforced silicon carbide composite (SiC/SiC CMC) material fabricated via chemical vapor infiltration. This insert was 45-mils thick and occupied a recessed area in the leading edge and shroud of the vane. It was designed to be free floating with an end cap design. The HPBR tests provided a comparative evaluation of the temperature response and leading-edge durability and included cycling the airfoils between simulated idle, lift, and cruise flight conditions. In addition, the airfoils were aircooled, uniquely instrumented, and exposed to the exact set of internal and external conditions, which included gas temperatures in excess of 1370 C (2500 F). In addition to documenting the temperature response of the metal vane for comparison with the CMC, a demonstration of improved leading-edge durability was a primary goal. First, the metal vane was tested for a total of 150 cycles. Both the leading edge and trailing edge of the blade exhibited fatigue cracking and burn-through similar to the failures experienced in service by the F402 engine. Next, an airfoil, fitted with the ceramic leading edge insert, was exposed for 200 cycles. The temperature response of those HPBR cycles indicated a reduced internal metal temperature, by as much as 600 F at the midspan location for the same surface temperature (2100 F). After testing, the composite insert appeared intact, with no signs of failure on either the vane s leading or trailing edge. Only a slight oxide scale, as would be expected, was noted on the insert. Overall, the CMC insert performed similarly to a thick thermal barrier coating. With a small air gap between the metal and the SiC/SiC leading edge, heat transfer from the CMC to the metal alloy was low, effectively lowering the temperatures. The insert's performance has proven that an uncooled CMC can be engineered and designed to withstand the thermal up-shock experienced during the severe lift conditions in the Pegasus engine. The design of the leading-edge insert, which minimized thermal stresses in the SiC/SiC CMC, showed that the CMC/metal assembly can be engineered to be a functioning component.
Author
Airfoils; Ceramic Matrix Composites; Leading Edges; Turbines; Simulation; Gas Turbines; Fabrication

20050192360 Pratt and Whitney Aircraft, West Palm Beach, FL, USA, United Technologies Corp., East Hartford, CT, USA
Engine-Scale Combustor Rig Designed, Fabricated, and Tested for Combustion Instability Control Research
DeLaat, John C.; Breisacher, Kevin J.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Low-emission combustor designs are prone to combustor instabilities. Because active control of these instabilities may allow future combustors to meet both stringent emissions and performance requirements, an experimental combustor rig was developed for investigating methods of actively suppressing combustion instabilities. The experimental rig has features similar to a real engine combustor and exhibits instabilities representative of those in aircraft gas turbine engines. Experimental testing in the spring of 1999 demonstrated that the rig can be tuned to closely represent an instability observed in engine tests. Future plans are to develop and demonstrate combustion instability control using this experimental combustor rig. The NASA Glenn Research Center at Lewis Field is leading the Combustion Instability Control program to investigate methods for actively suppressing combustion instabilities. Under this program, a single-nozzle, liquid-fueled research combustor rig was designed, fabricated, and tested. The rig has many of the complexities of a real engine combustor, including an actual fuel nozzle and swirler, dilution cooling, and an effusion-cooled liner. Prior to designing the experimental rig, a survey of aircraft engine combustion instability experience identified an instability observed in a prototype engine as a suitable candidate for replication. The frequency of the instability was 525 Hz, with an amplitude of approximately 1.5-psi peak-to-peak at a burner pressure of 200 psia. The single-nozzle experimental combustor rig was designed to preserve subcomponent lengths, cross sectional area distribution, flow distribution, pressure-drop distribution, temperature distribution, and other factors previously found to be determinants of burner acoustic frequencies, mode shapes, gain, and damping. Analytical models were used to predict the acoustic resonances of both the engine combustor and proposed experiment. The analysis confirmed that the test

rig configuration and engine configuration had similar longitudinal acoustic characteristics, increasing the likelihood that the engine instability would be replicated in the rig. Parametric analytical studies were performed to understand the influence of geometry and condition variations and to establish a combustion test plan. Cold-flow experiments verified that the design values of area and flow distributions were obtained. Combustion test results established the existence of a longitudinal combustion instability in the 500-Hz range with a measured amplitude approximating that observed in the engine. Modifications to the rig configuration during testing also showed the potential for injector independence. The research combustor rig was developed in partnership with Pratt & Whitney of West Palm Beach, Florida, and United Technologies Research Center of East Hartford, Connecticut. Experimental testing of the combustor rig took place at United Technologies Research Center.
Author
Active Control; Combustion Chambers; Combustion Stability; Engine Tests; Fabrication; Gas Turbine Engines; Mathematical Models

20050192407 NASA Glenn Research Center, Cleveland, OH, USA, Cleveland State Univ., Cleveland, OH, USA
Applicability of a Crack-Detection System for Use in Rotor Disk Spin Test Experiments Being Evaluated
Abdul-Aziz, Ali; Baaklini, George Y.; Roth, Don J.; Research and Technology 2003; May 2004; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Engine makers and aviation safety government institutions continue to have a strong interest in monitoring the health of rotating components in aircraft engines to improve safety and to lower maintenance costs. To prevent catastrophic failure (burst) of the engine, they use nondestructive evaluation (NDE) and major overhauls for periodic inspections to discover any cracks that might have formed. The lowest cost fluorescent penetrant inspection NDE technique can fail to disclose cracks that are tightly closed during rest or that are below the surface. The NDE eddy current system is more effective at detecting both crack types, but it requires careful setup and operation and only a small portion of the disk can be practically inspected. So that sensor systems can sustain normal function in a severe environment, health-monitoring systems require the sensor system to transmit a signal if a crack detected in the component is above a predetermined length (but below the length that would lead to failure) and lastly to act neutrally upon the overall performance of the engine system and not interfere with engine maintenance operations. Therefore, more reliable diagnostic tools and high-level techniques for detecting damage and monitoring the health of rotating components are very essential in maintaining engine safety and reliability and in assessing life.
Author
Aircraft Safety; Spin Tests; Detection; Rotation; Nondestructive Tests; Flight Safety; Turbine Wheels

20050192415 NASA Glenn Research Center, Cleveland, OH, USA, Ohio Aerospace Inst., OH, USA
Vibration-Based Data Used to Detect Cracks in Rotating Disks
Gyekenyesi, Andrew L.; Sawicki, Jerzy T.; Martin, Richard E.; Baaklini, George Y.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Rotor health monitoring and online damage detection are increasingly gaining the interest of aircraft engine manufacturers. This is primarily due to the fact that there is a necessity for improved safety during operation as well as a need for lower maintenance costs. Applied techniques for the damage detection and health monitoring of rotors are essential for engine safety, reliability, and life prediction. Recently, the USA set the ambitious goal of reducing the fatal accident rate for commercial aviation by 80 percent within 10 years. In turn, NASA, in collaboration with the Federal Aviation Administration, other Federal agencies, universities, and the airline and aircraft industries, responded by developing the Aviation Safety Program. This program provides research and technology products needed to help the aerospace industry achieve their aviation safety goal. The Nondestructive Evaluation (NDE) Group of the Optical Instrumentation Technology Branch at the NASA Glenn Research Center is currently developing propulsion-system-specific technologies to detect damage prior to catastrophe under the propulsion health management task. Currently, the NDE group is assessing the feasibility of utilizing real-time vibration data to detect cracks in turbine disks. The data are obtained from radial blade-tip clearance and shaft-clearance measurements made using capacitive or eddy-current probes. The concept is based on the fact that disk cracks distort the strain field within the component. This, in turn, causes a small deformation in the disk's geometry as well as a possible change in the system's center of mass. The geometric change and the center of mass shift can be indirectly characterized by monitoring the amplitude and phase of the first harmonic (i.e., the 1 component) of the vibration data. Spin pit experiments and full-scale engine tests have been conducted while monitoring for crack growth with this detection methodology. Even so, published data are extremely limited, and the basic foundation of the methodology has not been fully studied. The NDE group is working on developing this foundation on the basis of theoretical modeling as well as experimental data by using the newly constructed

subscale spin system shown in the preceding photograph. This, in turn, involved designing an optimal sub-scale disk that was meant to represent a full-scale turbine disk; conducting finite element analyses of undamaged and damaged disks to define the disk's deformation and the resulting shift in center of mass; and creating a rotordynamic model of the complete disk and shaft assembly to confirm operation beyond the first critical concerning the subscale experimental setup. The finite element analysis data, defining the center of mass shift due to disk damage, are shown. As an example, the change in the center of mass for a disk spinning at 8000 rpm with a 0.963-in. notch was 1.3 x 10(exp -4) in. The actual vibration response of an undamaged disk as well as the theoretical response of a cracked disk is shown. Experiments with cracked disks are continuing, and new approaches for analyzing the captured vibration data are being developed to better detect damage in a rotor. In addition, the subscale spin system is being used to test the durability and sensitivity of new NDE sensors that focus on detecting localized damage. This is designed to supplement the global response of the crack-detection methodology described here.
Author (revised)
Crack Propagation; Detection; Rotating Disks; Vibration; Systems Health Monitoring; Mathematical Models; Aircraft Engines

20050192420 NASA Glenn Research Center, Cleveland, OH, USA, General Electric Aircraft Engines, Cincinnati, OH, USA
Structural Simulations of Engine-Airframe Systems Being Improved
Lawrence, Charles; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The current environment for designing engine and engine-airframe structural systems requires extensive efforts to prepare and integrate models, generate analysis results, and postprocess data. Despite these efforts, the accuracy of the simulations is inadequate, leading to less than optimal designs, costly testing and redesigns, and most important, significant uncertainties in safety factors. The goal of this project is to develop improved tools for structural simulations of engine-airframe systems. To develop these new tools, the NASA Glenn Research Center at Lewis Field has teamed with GE Aircraft Engines, Pratt & Whitney, and Boeing Commercial Aircraft. Boeing brings a wealth of large-scale, complex, structural systems analysis experiences and capabilities to the team, while GE and Pratt & Whitney bring aircraft-engine-specific structural expertise.
Derived from text
Airframes; Aircraft Engines

20050192431 NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA
Effect of Impact Location on the Response of Shuttle Wing Leading Edge Panel 9
Lyle, Karen H.; Spellman, Regina L.; Hardy, Robin C.; Fasanella, Edwin L.; Jackson, Karen E.; July 2005; 14 pp.; In English
Contract(s)/Grant(s): WU 23-376-70-30-07
Report No.(s): NASA/TM-2005-213544; ARL-TR-3426; L-19088; No Copyright; Avail: CASI; A03, Hardcopy

The objective of this paper is to compare the results of several simulations performed to determine the worst-case location for a foam impact on the Space Shuttle wing leading edge. The simulations were performed using the commercial non-linear transient dynamic finite element code, LS-DYNA. These simulations represent the first in a series of parametric studies performed to support the selection of the worst-case impact scenario. Panel 9 was selected for this study to enable comparisons with previous simulations performed during the Columbia Accident Investigation. The projectile for this study is a 5.5-in cube of typical external tank foam weighing 0.23 lb. Seven locations spanning the panel surface were impacted with the foam cube. For each of these cases, the foam was traveling at 1000 ft/s directly aft, along the orbiter X-axis. Results compared from the parametric studies included strains, contact forces, and material energies for various simulations. The results show that the worst case impact location was on the top surface, near the apex.
Author
Leading Edges; Space Shuttles; Wing Panels; Impact Loads; Simulation; Metal Foams; External Tanks

07
AIRCRAFT PROPULSION AND POWER

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; 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*.

20050186906 Michigan Technological Univ., Houghton, MI, USA

A Parametric Cycle Analysis of a Separate-Flow Turbofan with Interstage Turbine Burner

Marek, C. J., Technical Monitor; Liew, K. H.; Urip, E.; Yang, S. L.; June 2005; 18 pp.; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA

Contract(s)/Grant(s): NAG3-2759; WBS 22-066-10-12

Report No.(s): NASA/CR-2005-213657; AIAA Paper 2004-3311; E-15147; No Copyright; Avail: CASI; A03, Hardcopy

Today's modern aircraft is based on air-breathing jet propulsion systems, which use moving fluids as substances to transform energy carried by the fluids into power. Throughout aero-vehicle evolution, improvements have been made to the engine efficiency and pollutants reduction. This study focuses on a parametric cycle analysis of a dual-spool, separate-flow turbofan engine with an Interstage Turbine Burner (ITB). The ITB considered in this paper is a relatively new concept in modern jet engine propulsion. The JTB serves as a secondary combustor and is located between the high- and the low-pressure turbine, i.e., the transition duct. The objective of this study is to use design parameters, such as flight Mach number, compressor pressure ratio, fan pressure ratio, fan bypass ratio, linear relation between high- and low-pressure turbines, and high-pressure turbine inlet temperature to obtain engine performance parameters, such as specific thrust and thrust specific fuel consumption. Results of this study can provide guidance in identifying the performance characteristics of various engine components, which can then be used to develop, analyze, integrate, and optimize the system performance of turbofan engines with an ITB.

Author

Propulsion System Configurations; Turbofan Engines; Burners; Air Breathing Engines; Design Analysis; Ducted Flow; Jet Propulsion

20050187007 NASA Lewis Research Center, Cleveland, OH, USA

High-Temperature Solid Lubricants Developed by NASA Lewis Offer Virtually 'Unlimited Life' for Oil-Free Turbomachinery

DellaCorte, Christopher; Valco, Mark J.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Lewis Research Center is capitalizing on breakthroughs in foil air bearing performance, tribological coatings, and computer analyses to formulate the Oil-free Turbomachinery Program. The program s long-term goal is to develop an innovative, yet practical, oil-free aeropropulsion gas turbine engine that floats on advanced air bearings. This type of engine would operate at higher speeds and temperatures with lower weight and friction than conventional oil-lubricated engines. During startup and shutdown, solid lubricant coatings are required to prevent wear in such engines before the self-generating air-lubrication film develops. NASA s Tribology Branch has created PS304, a chrome-oxide-based plasma spray coating specifically tailored for shafts run against foil bearings. PS304 contains silver and barium fluoride/calcium fluoride eutectic (BaF2/CaF2) lubricant additives that, together, provide lubrication from cold start temperatures to over 650 C, the maximum use temperature for foil bearings. Recent lab tests show that bearings lubricated with PS304 survive over 100 000 start-stop cycles without experiencing any degradation in performance due to wear. The accompanying photograph shows a test bearing after it was run at 650 C. The rubbing process created a 'polished' surface that enhances bearing load capacity.

Author

Solid Lubricants; High Temperature Lubricants; Gas Turbine Engines; Turbomachinery; Self Lubrication; Foil Bearings

20050187083 General Electric Co., Schenectady, NY, USA

Utility Advanced Turbine Systems (ATS) Technology Readiness Testing, Phase 3R, Volume 1, Program Overview

Jun. 2001; 372 pp.; In English

Report No.(s): DE2005-828052; No Copyright; Avail: Department of Energy Information Bridge

The following paper provides an overview of GE's H System(TM) technology, and specifically, the design, development, and test activities associated with the DOE Advanced Turbine Systems (ATS) program. There was intensive effort expended in bringing this revolutionary advanced technology program to commercial reality. In addition to describing the magnitude of performance improvement possible through use of H System(TM) technology, this paper discusses the technological

milestones during the development of the first 9H (50Hz) and 7H (60 Hz) gas turbines.
NTIS
ATS; Cycles; Gas Turbines; Technology Assessment; Turbines

20050188445 NASA Glenn Research Center, Cleveland, OH, USA
Performance Cycle Analysis of a Two-Spool, Separate-Exhaust Turbofan With Interstage Turbine Burner
Liew, K. H.; Urip, E.; Yang, S. L.; Mattingly, J. D.; Marek, C. J.; June 2005; 31 pp.; In English
Contract(s)/Grant(s): WBS 22-066-10-12
Report No.(s): NASA/TM-2005-213660; E-15150; AIAA Paper 2004-3311; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents the performance cycle analysis of a dual-spool, separate-exhaust turbofan engine, with an Interstage Turbine Burner serving as a secondary combustor. The ITB, which is located at the transition duct between the high- and the low-pressure turbines, is a relatively new concept for increasing specific thrust and lowering pollutant emissions in modern jet engine propulsion. A detailed performance analysis of this engine has been conducted for steady-state engine performance prediction. A code is written and is capable of predicting engine performances (i.e., thrust and thrust specific fuel consumption) at varying flight conditions and throttle settings. Two design-point engines were studied to reveal trends in performance at both full and partial throttle operations. A mission analysis is also presented to assure the advantage of saving fuel by adding ITB.
Author
Turbofans; Turbines; Spools; Turbine Engines

20050188523 NASA Lewis Research Center, Cleveland, OH, USA
Distortion Tolerant Control Flight Demonstration Shown to Be Successful
Litt, Jonathan S.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Future aircraft turbine engines, both commercial and military, will have to be able to successfully accommodate expected increased levels of steady-state and dynamic engine-face distortion. Advanced tactical aircraft are likely to use thrust vectoring for enhanced aircraft maneuverability. As a result, the engines will see more extreme distortion levels than currently encountered with present-day aircraft. Also, the mixed-compression inlets needed for the High-Speed Civil Transport (HSCT) will likely encounter disturbances similar to those seen by tactical aircraft, in addition to planar pulse, inlet buzz, and high distortion levels at low flight speed and off-design operation. The current approach of incorporating sufficient component design stall margin to tolerate these expected levels of distortion would result in significant performance penalties. The objectives of NASA's High Stability Engine Control (HISTEC) program, which has reached a highly successful conclusion, were to design, develop, and flight demonstrate an advanced, high-stability, integrated engine control system that uses measurement-based real-time estimates of distortion to enhance engine stability. The resulting distortion tolerant control adjusts the stall margin requirement online in real time. This reduces the design stall margin requirement, with a corresponding increase in performance and decrease in fuel burn.
Derived from text
Aircraft Engines; Engine Control; Distortion; Warpage; Deformation

20050188545 NASA Lewis Research Center, Cleveland, OH, USA
Composite Nozzle/Thrust Chambers Analyzed for Low-Cost Boosters
Sullivan, Roy M.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Low Cost Booster Technology Program is an initiative to minimize the cost of future liquid engines by using advanced materials and innovative designs, and by reducing engine complexity. NASA Marshall Space Flight Center s 60K FASTRAC Engine is one example where these design philosophies have been put into practice. This engine burns a liquid kerosene/oxygen mixture. It uses a one-piece, polymer composite thrust chamber/nozzle that is constructed of a tape-wrapped silica phenolic liner, a metallic injector interface ring, and a filament-wound epoxy overwrap. A cooperative effort between NASA Lewis Research Center s Structures Division and Marshall is underway to perform a finite element analysis of the FASTRAC chamber/nozzle under all the loading and environmental conditions that it will experience during its lifetime. The chamber/nozzle is a complex composite structure. Of its three different materials, the two composite components have distinctly different fiber architectures and, consequently, require separate material model descriptions. Since the liner is tape wrapped, it is orthotropic in the nozzle global coordinates; and since the overwrap is filament wound, it is treated as a monoclinic material. Furthermore, the wind angle on the overwrap varies continuously along the length of the chamber/nozzle.
Derived from text
Thrust Chambers; Low Cost; Nozzle Design

20050188546 NASA Lewis Research Center, Cleveland, OH, USA

Flutter Version of Propulsion Aeroelasticity Code Completed

Bakhle, Milind A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA s Advanced Subsonic Technology (AST) Program seeks to develop new technologies to increase the fuel efficiency of commercial aircraft engines, improve the safety of engine operation, and reduce emissions and engine noise. For new designs of ducted fans, compressors, and turbines to achieve these goals, a basic aeroelastic requirement is that there should be no flutter or high resonant blade stresses in the operating regime. For verifying the aeroelastic soundness of the design, an accurate prediction/analysis code is required. Such a three-dimensional viscous propulsion aeroelastic code, named TURBO-AE, is being developed at the NASA Lewis Research Center. The development and verification of the flutter version of the TURBO-AE code (version 4) has been completed. Validation of the code is partially complete.

Derived from text

Flutter; Aeroelasticity; Design Analysis; Propulsion

20050188549 NASA Lewis Research Center, Cleveland, OH, USA

Two-Dimensional Bifurcated Inlet/Engine Tests Completed in 10- by 10-Foot Supersonic Wind Tunnel

Saunders, John D.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A Two-Dimensional Bifurcated (2DB) Inlet was successfully tested in NASA Lewis Research Center s 10- by 10-Foot Supersonic Wind Tunnel. These tests were the culmination of a collaborative effort between the Boeing Company, General Electric, Pratt & Whitney, and Lewis. Extensive support in-house at Lewis contributed significantly to the progress and accomplishment of this test. The results, which met or exceeded many of the High-Speed Research (HSR) Program goals, were used to revise system studies within the HSR Program. The HSR Program is focused on developing low-noise, low-polluting, high-efficiency supersonic commercial aircraft. A supersonic inlet is an important component of an efficient, low-noise vehicle.

Author

Supersonic Wind Tunnels; Supersonic Inlets; Wind Tunnel Tests

20050192097 NASA Glenn Research Center, Cleveland, OH, USA

Noise-Reduction Benefits Analyzed for Over-the-Wing-Mounted Advanced Turbofan Engines

Berton, Jeffrey J.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As we look to the future, increasingly stringent civilian aviation noise regulations will require the design and manufacture of extremely quiet commercial aircraft. Also, the large fan diameters of modern engines with increasingly higher bypass ratios pose significant packaging and aircraft installation challenges. One design approach that addresses both of these challenges is to mount the engines above the wing. In addition to allowing the performance trend towards large diameters and high bypass ratio cycles to continue, this approach allows the wing to shield much of the engine noise from people on the ground. The Propulsion Systems Analysis Office at the NASA Glenn Research Center at Lewis Field conducted independent analytical research to estimate the noise reduction potential of mounting advanced turbofan engines above the wing. Certification noise predictions were made for a notional long-haul commercial quadjet transport. A large quad was chosen because, even under current regulations, such aircraft sometimes experience difficulty in complying with certification noise requirements with a substantial margin. Also, because of its long wing chords, a large airplane would receive the greatest advantage of any noise-shielding benefit.

Author

Turbofan Engines; Jet Aircraft Noise; Engine Noise; Aeroacoustics; Noise Reduction; Engine Airframe Integration

20050192115 NASA Lewis Research Center, Cleveland, OH, USA

Low-Noise Potential of Advanced Fan Stage Stator Vane Designs Verified in NASA Lewis Wind Tunnel Test

Hughes, Christopher E.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

With the advent of new, more stringent noise regulations in the next century, aircraft engine manufacturers are investigating new technologies to make the current generation of aircraft engines as well as the next generation of advanced engines quieter without sacrificing operating performance. A current NASA initiative called the Advanced Subsonic Technology (AST) Program has set as a goal a 6-EPNdB (effective perceived noise) reduction in aircraft engine noise relative to 1992 technology levels by the year 2000. As part of this noise program, and in cooperation with the Allison Engine Company, an advanced, low-noise, high-bypass-ratio fan stage design and several advanced technology stator vane designs

were recently tested in NASA Lewis Research Center's 9- by 15-Foot Low-Speed Wind Tunnel (an anechoic facility). The project was called the NASA/Allison Low Noise Fan.
Derived from text
Noise Reduction; Vanes; Engine Noise; Stators; Aircraft Noise

20050192122 NASA Lewis Research Center, Cleveland, OH, USA
Solid Surface Combustion Experiment Yields Significant Observations
Sacksteder, Kurt R.; Koudelka, John M.; Vergilii, Franklin; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The spread of a flame over solid fuel is not only a fundamental textbook combustion phenomenon, but also the central element of destructive fires that cause tragic loss of life and property each year. Throughout history, practical measures to prevent and fight fires have been developed, but these have often been based on lessons learned in a costly fire. Since the 1960 s, scientists and engineers have employed powerful tools of scientific research to understand the details of flame spread and how a material can be rendered nonflammable. High-speed computers have enabled complex flame simulations, whereasand lasers have provided measurements of the chemical composition, temperature, and air velocities inside flames. The microgravity environment has emerged as the third great tool for these studies. Spreading flames are complex combinations of chemical reactions and several physical processes including the transport of oxygen and fuel vapor to the flame and the transfer of heat from the flame to fresh fuel and to the surroundings. Depending on its speed, air motion in the vicinity of the flame can affect the flame in substantially different ways. For example, consider the difference between blowing on a campfire and blowing out a match. On Earth, gravity induces air motion because of buoyancy (the familiar rising hot gases); this process cannot be controlled experimentally. For theoreticians, buoyant air motion complicates the problem modeling of flame spread beyond the capacity of modern computers to simulate. The microgravity environment provides experimental control of air motion near spreading flames, with results that can be compared with detailed theory. The Solid Surface Combustion Experiment (SSCE) was designed to obtain benchmark flame spreading data in quiescent test atmospheres--the limiting case of flames spreading. Professor Robert Altenkirch, Vice President for Research at Mississippi State University, proposed the experiment concept, and the NASA Lewis Research Center designed, built, and tested the SSCE hardware. It was the first microgravity science experiment built by Lewis for the space shuttle and the first combustion science experiment flown in space.
Author
Combustion Physics; Fluid Flow; Solid Propellants; Solid Surfaces; Flame Propagation

20050192140 NASA Glenn Research Center, Cleveland, OH, USA, InDyne, Inc., USA
Ultra-Efficient Engine Technology Project Integrated Into NASA's Vehicle Systems Program
Shaw, Robert J.; Research and Technology 2003; May 2004; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Ultra-Efficient Engine Technology (UEET) Project is formulated according to the Office of Aerospace Technology's objectives as outlined in the NASA Strategic Plan. It is directly related to the 'protect the environment' objective and will make progress toward the 'increase mobility' and 'support national security' objectives as well. UEET technologies will impact future civil and military aircraft and will benefit the development of future space transportation propulsion systems. UEET Project success will, therefore, depend on developing revolutionary, but affordable, technology solutions that are inherently safe and reliable and thus can be incorporated in future propulsion system designs. In fiscal year 2003, UEET became part of NASA's Vehicle Systems Program and continues to evolve its programmatic role. The Vehicle Systems Program aims to develop breakthrough technologies and methodologies, push the boundaries of flight through research on advanced vehicle concepts, respond quickly to industry and the Department of Defense on critical safety and other issues, and provide facilities and expert consultation for industry and other Government agencies during product development.
Derived from text
Aircraft Engines; Engine Design; Propulsive Efficiency

20050192141 NASA Glenn Research Center, Cleveland, OH, USA
Performance of a Fuel-Cell-Powered, Small Electric Airplane Assessed
Berton, Jeffrey J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Rapidly emerging fuel-cell-power technologies may be used to launch a new revolution of electric propulsion systems for light aircraft. Future small electric airplanes using fuel cell technologies hold the promise of high reliability, low maintenance, low noise, and - with the exception of water vapor - zero emissions. An analytical feasibility and performance assessment was

conducted by NASA Glenn Research Center's Airbreathing Systems Analysis Office of a fuel-cell-powered, propeller-driven, small electric airplane based on a model of the MCR-01 two-place kitplane (Dyn'Aero, Darois, France). This assessment was conducted in parallel with an ongoing effort by the Advanced Technology Products Corporation and the Foundation for Advancing Science and Technology Education. Their project - partially funded by a NASA grant - is to design, build, and fly the first manned, continuously propelled, nongliding electric airplane. In our study, an analytical performance model of a proton exchange membrane (PEM) fuel cell propulsion system was developed and applied to a notional, two-place light airplane modeled after the MCR-01 kitplane. The PEM fuel cell stack was fed pure hydrogen fuel and humidified ambient air via a small automotive centrifugal supercharger. The fuel cell performance models were based on chemical reaction analyses calibrated with published data from the fledgling U.S. automotive fuel cell industry. Electric propeller motors, rated at two shaft power levels in separate assessments, were used to directly drive a two-bladed, variable-pitch propeller. Fuel sources considered were compressed hydrogen gas and cryogenic liquid hydrogen. Both of these fuel sources provided pure, contaminant-free hydrogen for the PEM cells.
Author
Feasibility Analysis; Fuel Cells; Propulsion System Performance; Electric Motors; Light Aircraft; Performance Prediction

20050192148 NASA Glenn Research Center, Cleveland, OH, USA
Critical Low-Noise Technologies Being Developed for Engine Noise Reduction Systems Subproject
Grady, Joseph E.; Civinskas, Kestutis C.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA's previous Advanced Subsonic Technology (AST) Noise Reduction Program delivered the initial technologies for meeting a 10-year goal of a 10-dB reduction in total aircraft system noise. Technology Readiness Levels achieved for the engine-noise-reduction technologies ranged from 4 (rig scale) to 6 (engine demonstration). The current Quiet Aircraft Technology (QAT) project is building on those AST accomplishments to achieve the additional noise reduction needed to meet the Aerospace Technology Enterprise's 10-year goal, again validated through a combination of laboratory rig and engine demonstration tests. In order to meet the Aerospace Technology Enterprise goal for future aircraft of a 50- reduction in the perceived noise level, reductions of 4 dB are needed in both fan and jet noise. The primary objectives of the Engine Noise Reduction Systems (ENRS) subproject are, therefore, to develop technologies to reduce both fan and jet noise by 4 dB, to demonstrate these technologies in engine tests, and to develop and experimentally validate Computational Aero Acoustics (CAA) computer codes that will improve our ability to predict engine noise.
Author
Technology Assessment; Jet Aircraft Noise; Noise Reduction; Engine Noise; Aeroacoustics

20050192151 NASA Glenn Research Center, Cleveland, OH, USA
Performance Benefits for a Turboshaft Engine Using Nonlinear Engine Control Technology Investigated
Jones, Scott M.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The potential benefits of nonlinear engine control technology applied to a General Electric T700 helicopter engine were investigated. This technology is being developed by the U.S. Navy SPAWAR Systems Center for a variety of applications. When used as a means of active stability control, nonlinear engine control technology uses sensors and small amounts of injected air to allow compressors to operate with reduced stall margin, which can improve engine pressure ratio. The focus of this study was to determine the best achievable reduction in fuel consumption for the T700 turboshaft engine. A customer deck (computer code) was provided by General Electric to calculate the T700 engine performance, and the NASA Glenn Research Center used this code to perform the analysis. The results showed a 2- to 5-percent reduction in brake specific fuel consumption (BSFC) at the three Sikorsky H-60 helicopter operating points of cruise, loiter, and hover.
Author
Propulsion System Performance; Nonlinearity; Engine Control; H-60 Helicopter; Fuel Consumption

20050192206 NASA Glenn Research Center, Cleveland, OH, USA
Systems Analysis Developed for All-Electric Aircraft Propulsion
Kohout, Lisa L.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

There is a growing interest in the use of fuel cells as a power source for all-electric aircraft propulsion as a means to substantially reduce or eliminate environmentally harmful emissions. Among the technologies under consideration for these concepts are advanced proton exchange membrane (PEM) and solid oxide fuel cells (SOFCs), alternative fuels and fuel processing, and fuel storage. A multidisciplinary effort is underway at the NASA Glenn Research Center to develop and

evaluate concepts for revolutionary, nontraditional fuel cell power and propulsion systems for aircraft applications. As part of this effort, system studies are being conducted to identify concepts with high payoff potential and associated technology areas for further development. To support this effort, a suite of component models was developed to estimate the mass, volume, and performance for a given system architecture. These models include a hydrogen-air PEM fuel cell; an SOFC; balance-of-plant components (compressor, humidifier, separator, and heat exchangers); compressed gas, cryogenic, and liquid fuel storage tanks; and gas turbine/generator models for hybrid system applications. First-order feasibility studies were completed for an all-electric personal air vehicle utilizing a fuel-cell-powered propulsion system. A representative aircraft with an internal combustion engine was chosen as a baseline to provide key parameters to the study, including engine power and subsystem mass, fuel storage volume and mass, and aircraft range. The engine, fuel tank, and associated ancillaries were then replaced with a fuel cell subsystem. Various configurations were considered including a PEM fuel cell with liquid hydrogen storage, a direct methanol PEM fuel cell, and a direct internal reforming SOFC/turbine hybrid system using liquid methane fuel. Each configuration was compared with the baseline case on a mass and range basis.
Author
Systems Analysis; Aircraft Engines; Fuel Cells

20050192358 NASA Glenn Research Center, Cleveland, OH, USA
Surge Flow in a Centrifugal Compressor Measured by Digital Particle Image Velocimetry
Wernet, Mark P.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A planar optical velocity measurement technique known as Particle Image Velocimetry (PIV) is being used to study transient events in compressors. In PIV, a pulsed laser light sheet is used to record the positions of particles entrained in a fluid at two instances in time across a planar region of the flow. Determining the recorded particle displacement between exposures yields an instantaneous velocity vector map across the illuminated plane. Detailed flow mappings obtained using PIV in high-speed rotating turbomachinery components are used to improve the accuracy of computational fluid dynamics (CFD) simulations, which in turn, are used to guide advances in state-of-the-art aircraft engine hardware designs.
Derived from text
Compressors; Centrifugal Compressors; Particle Image Velocimetry

20050192368 NASA Glenn Research Center, Cleveland, OH, USA
Turbine Blade and Endwall Heat Transfer Measured in NASA Glenn's Transonic Turbine Blade Cascade
Giel, Paul W.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Higher operating temperatures increase the efficiency of aircraft gas turbine engines, but can also degrade internal components. High-pressure turbine blades just downstream of the combustor are particularly susceptible to overheating. Computational fluid dynamics (CFD) computer programs can predict the flow around the blades so that potential hot spots can be identified and appropriate cooling schemes can be designed. Various blade and cooling schemes can be examined computationally before any hardware is built, thus saving time and effort. Often though, the accuracy of these programs has been found to be inadequate for predicting heat transfer. Code and model developers need highly detailed aerodynamic and heat transfer data to validate and improve their analyses. The Transonic Turbine Blade Cascade was built at the NASA Glenn Research Center at Lewis Field to help satisfy the need for this type of data.
Derived from text
Turbine Blades; Supersonic Turbines; Aerodynamic Heat Transfer; Heat Transfer

20050192369 NASA Glenn Research Center, Cleveland, OH, USA, Army Research Lab., Cleveland, OH, USA
Accuracy of Numerical Simulations of Tip Clearance Flow in Transonic Compressor Rotors Improved Dramatically
VanZante, Dale E.; Strazisar, Anthony J.; Wood, Jerry R.; Hathaway, Michael D.; Okiishi, Theodore H.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The tip clearance flows of transonic compressor rotors have a significant impact on rotor and stage performance. Although numerical simulations of these flows are quite sophisticated, they are seldom verified through rigorous comparisons of numerical and measured data because, in high-speed machines, measurements acquired in sufficient detail to be useful are rare. Researchers at the NASA Glenn Research Center at Lewis Field compared measured tip clearance flow details (e.g., trajectory and radial extent) of the NASA Rotor 35 with results obtained from a numerical simulation. Previous investigations had focused on capturing the detailed development of the jetlike flow leaking through the clearance gap between the rotating blade tip and the stationary compressor shroud. However, we discovered that the simulation accuracy depends primarily on

capturing the detailed development of a wall-bounded shear layer formed by the relative motion between the leakage jet and the shroud.
Derived from text
Transonic Compressors; Compressor Rotors; Compressors; Rotors

20050192416 NASA Glenn Research Center, Cleveland, OH, USA
Propulsion Aeroelastic Analysis Developed for Flutter and Forced Response
Bakhle, Milind A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center at Lewis Field develops new technologies to increase the fuel efficiency of aircraft engines, improve the safety of engine operation, reduce emissions, and reduce engine noise. With the development of new designs for fans, compressors, and turbines to achieve these goals, the basic aeroelastic requirements are that there should be no flutter (self-excited vibrations) or high resonant blade stresses (due to forced response) in the operating regime. Therefore, an accurate prediction and analysis capability is required to verify the aeroelastic soundness of the designs. Such a three-dimensional viscous propulsion aeroelastic analysis capability has been developed at Glenn with support from the Advanced Subsonic Technology (AST) program. This newly developed aeroelastic analysis capability is based on TURBO, a threedimensional unsteady aerodynamic Reynolds-averaged Navier-Stokes turbomachinery code developed previously under a grant from Glenn. TURBO can model the viscous flow effects that play an important role in certain aeroelastic problems such as flutter with flow separation, flutter at high loading conditions near the stall line (stall flutter), flutter in the presence of shock and boundary-layer interaction, and forced response due to wakes and shock impingement. In aeroelastic analysis, the structural dynamics representation of the blades is based on normal modes. A finite-element analysis code is used to calculate these in-vacuum vibration modes and the associated natural frequencies. In an aeroelastic analysis using the TURBO code, flutter and forced response are modeled as being uncoupled. To calculate if a blade row will flutter, one prescribes the motion of the blade to be a harmonic vibration in a specified in-vacuum normal mode. An aeroelastic analysis preprocessor is used to generate the displacement field required for the analysis. The work done by aerodynamic forces on the vibrating blade during a cycle of vibration is calculated. If this work is positive, the blade is dynamically unstable, since it will extract energy from the flow, leading to an increase in the blade s oscillation amplitude. The forced-response excitations on a blade row are calculated by modeling the flow through two adjacent blade rows using the TURBO code. The blades are assumed to be rigid. As an option, a single blade row can be modeled with the upstream blade row influence represented by a time-varying disturbance (gust) at the inlet boundary. The unsteady forces on a blade row from such analyses are used in a structural analysis along with the blade structural dynamics characteristics and aerodynamic damping associated with blade vibration to calculate the resulting dynamic stresses on the blade.
Author
Aeroelasticity; Flutter; Navier-Stokes Equation; Reynolds Averaging; Turbomachinery; Viscous Flow; Boundary Layer Separation; Vibration Mode; Finite Element Method

20050192424 NASA Glenn Research Center, Cleveland, OH, USA, Lockheed Martin Aeronautics Co., Valley Forge, PA, USA
Stirling Convertor for the Stirling Radioisotope Generator Tested as a Prelude to Transition to Flight
Schreiber, Jeffrey G.; Thieme, Lanny G.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Stirling Radioisotope Generator (SRG) is currently being developed by Lockheed Martin Astronautics (Valley Forge, PA) under contract to the Department of Energy (Germantown, MD). In support of this project, the NASA Glenn Research Center has established a near-term technology effort to provide some of the critical data to ensure a successful transition to flight for what will be the first dynamic power system to be used in space. The generator will be a high-efficiency electric power source for potential use on NASA space science missions. The generator will be able to operate in the vacuum of deep space or in an atmosphere such as on the surface of Mars. High system efficiency is obtained through the use of free-piston Stirling power-conversion technology. The power output of the generator will be greater than 100 W at the beginning of life, with the slow decline in power being largely due to decay of the plutonium heat source. Previously, Glenn's supporting technology efforts focused only on the most critical technical issues.
Derived from text
Stirling Cycle; Thermodynamic Cycles

08
AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities, piloting, flight controls, and autopilots. For related information see also *05 Aircraft Design, Testing and Performance* and *06 Avionics and Aircraft Instrumentation*.

20050188498 NASA Lewis Research Center, Cleveland, OH, USA
Neural Networks Used to Compare Designed and Measured Time-Average Patterns
Decker, Arthur J.; Fite, E. Brian; Mehmed, Oral; Thorp, Scott A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Electronic time-average holograms are convenient for comparing the measured vibration modes of fan blades with those calculated by finite-element models. At the NASA Lewis Research Center, neural networks recently were trained to perform what had been a simple visual comparison of the predictions of the design models with the measurements. Finite-element models were used to train neural networks to recognize damage and strain information encoded in subtle changes in the time-average patterns of cantilevers. But the design-grade finite element models were unable to train the neural networks to detect damage in complex blade shapes. The design-model-generated patterns simply did not agree well enough with the measured patterns. Instead, hybrid-training records, with measured time-average patterns as the input and model-generated strain information as the output, were used to effect successful training.
Derived from text
Neural Nets; Compacting; Design Analysis; Time Measurement; Vibration Mode; Fan Blades

20050192434 NASA Langley Research Center, Hampton, VA, USA
Actively Controlling Buffet-Induced Excitations
Moses, Robert W.; Pototzky, Anthony S.; Henderson, Douglas A.; Galea, Stephen C.; Manokaran, Donald S.; Zimcik, David G.; Wickramasinghe, Viresh; Pitt, Dale M.; Gamble, Michael A.; [2005]; 12 pp.; In English; RTO/AVT-123 Symposium on Flow Induced Unsteady Loads and the Impact on Military Applications, 25-29 Apr. 2005, Budapest, Hungary; Original contains color illustrations
Contract(s)/Grant(s): 23-745-45-43
Report No.(s): RTO-MP-AVT-123; No Copyright; Avail: CASI; A03, Hardcopy

High performance aircraft, especially those with twin vertical tails, encounter unsteady buffet loads when flying at high angles of attack. These loads result in significant random stresses, which may cause fatigue damage leading to restricted capabilities and availability of the aircraft. An international collaborative research activity among Australia, Canada and the USA, conducted under the auspices of The Technical Cooperation Program (TTCP) contributed resources toward a program that coalesced a broad range of technical knowledge and expertise into a single investigation to demonstrate the enhanced performance and capability of the advanced active BLA control system in preparation for a flight test demonstration. The research team investigated the use of active structural control to alleviate the damaging structural response to these loads by applying advanced directional piezoelectric actuators, the aircraft rudder, switch mode amplifiers, and advanced control strategies on an F/A-18 aircraft empennage. Some results of the full-scale investigation are presented herein.
Author
Active Control; Buffeting; Excitation; F-18 Aircraft; Control Systems Design

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see *03 Air Transportation and Safety*. For astronautical facilities see *14 Ground Support Systems and Facilities (Space)*.

20050188508 NASA Lewis Research Center, Cleveland, OH, USA
Research Data Acquired in World-Class, 60-atm Subsonic Combustion Rig
Lee, Chi-Ming; Wey, Changlie; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Lewis Research Center's new, world-class, 60-atmosphere (atm) combustor research facility, the Advanced Subsonic Combustion Rig (ASCR), is in operation and producing highly unique research data. Specifically, data were acquired at high pressures and temperatures representative of future subsonic engines from a fundamental flametube configuration with

an advanced fuel injector. The data acquired include exhaust emissions as well as pressure and temperature distributions. Results to date represent an improved understanding of nitrous oxide (NOx) formation at high pressures and temperatures and include an NOx emissions reduction greater than 70 percent with an advanced fuel injector at operating pressures to 800 pounds per square inch absolute (psia). ASCR research is an integral part of the Advanced Subsonic Technology (AST) Propulsion Program. This program is developing critical low-emission combustion technology that will result in the next generation of gas turbine engines producing 50 to 70 percent less NOx emissions in comparison to 1996 International Civil Aviation Organization (ICAO) limits. The results to date indicate that the AST low-emission combustor goals of reducing NOx emissions by 50 to 70 percent are feasible. U.S. gas turbine manufacturers have started testing the low-emissions combustors at the ASCR. This collaborative testing will enable the industry to develop low-emission combustors at the high pressure and temperature conditions of future subsonic engines. The first stage of the flametube testing has been implemented. Four GE Aircraft Engines low-emissions fuel injector concepts, three Pratt & Whitney concepts, and two Allison concepts have been tested at Lewis ASCR facility. Subsequently, the flametube was removed from the test stand, and the sector combustor was installed. The testing of low emissions sector has begun. Low-emission combustors developed as a result of ASCR research will enable U.S. engine manufacturers to compete on a worldwide basis by producing environmentally acceptable commercial engines.
Author
Subsonic Flow; Data Acquisition; Technology Utilization; Combustion Chambers; Research Facilities

12
ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration see *91 Lunar and Planetary Science and Exploration*.

20050192087 NASA Langley Research Center, Hampton, VA, USA
POST II Trajectory Animation Tool Using MATLAB, V1.0
Raiszadeh, Behzad; July 2005; 18 pp.; In English; Original contains color and black and white illustrations
Report No.(s): NASA/TM-2005-213779; No Copyright; Avail: CASI; A03, Hardcopy

A trajectory animation tool has been developed for accurately depicting position and the attitude of the bodies in flight. The movies generated from This MATLAB based tool serve as an engineering analysis aid to gain further understanding into the dynamic behavior of bodies in flight. This tool has been designed to interface with the output generated from POST II simulations, and is able to animate a single as well as multiple vehicles in flight.
Author
Trajectory Analysis; Computer Animation; Computerized Simulation; Flight Vehicles; Computer Programs; Software Development Tools

15
LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing and Performance*; and *20 Spacecraft Propulsion and Power*.

20050189166 Army Ordnance Corps, Redstone Arsenal, AL USA
Army Ordnance Satellite Program
Satterfield, Paul H.; Akens, David S.; Nov. 1958; 180 pp.; In English
Report No.(s): AD-A434326; No Copyright; Avail: Defense Technical Information Center (DTIC)

The following 82 pages contain high points of Army Ordnance satellite history, beginning with scientists Hermann Oberth and Robert Goddard after World War I. Still to be written is a detailed, technical account. However, a long and helpful step in this direction is this history's contemporary, called Explorers In Orbit, a technically oriented study prepared by Vitro Engineering Company for the Army Ballistic Missile Agency. The Development Operations Division, ABMA, as well as the ABMA Historical Section have copies of this Vitro Study on file.
DTIC
Artificial Satellites; Missiles; Ordnance

20050189256 General Accounting Office, Washington, DC, USA

NASA: More Knowledge Needed to Determine Best Alternatives to Provide Space Station Logistics Support

May 2005; 28 pp.; In English

Report No.(s): PB2005-106868; GAO-05-488; No Copyright; Avail: CASI; A03, Hardcopy

The National Aeronautics and Space Administration's (NASA) space shuttle fleet has been key to International Space Station operations. Since the grounding of the fleet in February 2003, Russia has provided logistics support. However, due to the limited payload capacity of the Russian space vehicles, on-orbit assembly of the space station stopped. In May 2004 and in February 2005, NASA testified before the Congress that it had assessed using alternative launch vehicles to the space shuttle for space station operations. NASA concluded that using alternatives would be challenging and result in long program delays and would ultimately cost more than returning the space shuttle safely to flight. GAO was asked to determine whether NASA's assessment was sufficient to conclude that the space shuttle is the best option for assembling and providing logistics support to the space station.

NTIS

Alternatives; International Space Station; Logistics Management; Space Logistics

20050192381 NASA Glenn Research Center, Cleveland, OH, USA, Lockheed Martin Michoud Space Systems, USA

Propellant Densification Ground Testing Conducted for Launch Vehicles

Tomsik, Thomas M.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center at Lewis Field has taken the lead in the development of practical densified cryogenic propellants for launch vehicle applications. The technology of subcooling cryogenic propellants below their normal boiling point to produce a denser fluid is one of the key process technologies necessary to meet the challenge of single-stage-to-orbit and reusable launch vehicles. Densified propellants are critical to lowering launch costs because they enable more propellant to be packed into a given unit volume, thus improving the performance by reducing the overall size and weight of the launch vehicle. This two-pronged research and test program has evolved into (1) conducting tank loading tests using densified liquid hydrogen and (2) developing two large-scale propellant densification systems that will be performance tested next year at Glenn. The propellant-loading test program was undertaken at Glenn in coordination with Lockheed Martin Michoud Space Systems. In this testing, the liquid hydrogen recirculation and densification process was simulated, and the thermal stratification of the densified propellant was recorded throughout the tank. The test article was a flight-weight tank constructed from composite materials similar to those to be used on the X-33 launch vehicle. The tank geometry as designed by Lockheed Martin had two cylindrical lobes with a center septum. Liquid hydrogen flow rate, pressure data, and temperature data plotted over time were collected while the subscale tank was filled with 27 R (15 K) densified liquid hydrogen propellant. This testing has validated mathematical models and demonstrated the readiness of densified propellant technology for near-term use. It marks the first time that such a process has been carried out with a multiple-lobe, flight-similar tank. Glenn researchers have also been working on providing a process and critical test data for the continuous production of densified liquid hydrogen (LH2) and densified liquid oxygen (LO2). Each densification production process uses a high-efficiency, subatmospheric boiling bath heat exchanger to cool the working fluid. A near triple-point hydrogen boiling bath is used to condition and subcool hydrogen to 27 R (15 K), and a nitrogen boiling bath is used to cool the liquid oxygen to 120 R (66.7 K). Multistage centrifugal compressors operating at cryogenic inlet conditions maintain the heat exchanger bath vapor pressure below 1 atm. The LO2 propellant densification unit shown in the photograph has a 30 lb/sec capacity, whereas the LH2 unit was designed to process 8 lb/sec of propellant. Each densification unit will be transported to Glenn's South Forty area after all fabrication work is completed sometime late next year. There the LO2 and LH2 densifier performance tests will be conducted with another larger Lockheed Martin tank designated the Structural Test Article (STA). This liquid oxygen tank is a full-scale, flight-weight, prototype aluminum tank designed for the X-33. It has a capacity of 20,000 gallons of LO2. The tank loading and recirculation testing planned for next year with STA will provide the data necessary for full-scale development of propellant densification technology.

Author

Densification; Ground Tests; Launch Vehicles; Propellants; Mathematical Models; Technology Utilization

16
SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety; 15 Launch Vehicles and Launch Operations*; and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

20050192114 NASA Lewis Research Center, Cleveland, OH, USA

NASA Space Mechanisms Handbook: Lessons Learned Documented

Fusaro, Robert L.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The need to improve space mechanism reliability is underscored by a long history of flight failures and anomalies caused by malfunctioning mechanisms on spacecraft and launch vehicles. Some examples of these failures are listed in the table. Mechanism anomalies continue to occur and to be a cause of catastrophic mission failures. Several factors cause problems for space system mechanisms. The space environment produces wide temperature ranges, thermal gradients, and rapid changes in temperature, which can bind the moving parts of mechanisms. Ultraviolet radiation and vacuum cause the properties of many materials to degrade to unacceptable levels or to behave differently in space than on Earth, making it difficult to simulate operation during ground tests. The lack of gravity in space causes mechanisms to operate differently than on the ground. Sometimes the effects of zero gravity can be simulated to some degree in ground testing, such as by offloading the weight of a deployable appendage. Other effects, such as lubricant migration, cannot be simulated and must be considered in the design. Finally, the launch environment imposes severe dynamic loads on mechanisms and can cause structural damage, loosen fasteners, and damage delicate surfaces.

Derived from text

Aerospace Engineering; System Failures; Aborted Missions; Handbooks

17
SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

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

20050186925 National Inst. of Information and Communications Technology, Japan

Study on Laser Communications Demonstration Equipment at the International Space Station

Arimoto, Yoshinori; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 125-132; In English; See also 20050186915; Copyright; Avail: Other Sources

This paper summarizes CRL's efforts to perform a mission analysis and a feasibility study of the Laser Communications Demonstration Equipment (LCDE) that would have been attached to the International Space Station. The purpose of the LCDE was to demonstrate the capability of a high-speed two-way optical link with a bit-rate of 2.5 Gbps to communicate with a ground station. The development program, however, was terminated in February, 2003 due to development cost overrun and launch delays. The results reported in this paper will be used for a future multi-gigabit free-space laser communication system. Author

International Space Station; Optical Communication; Communication Equipment; Spacecraft Equipment

20050188506 NASA Lewis Research Center, Cleveland, OH, USA

K-Band Phased Array Developed for Low- Earth-Orbit Satellite Communications

Anzic, Godfrey; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Future rapid deployment of low- and medium-Earth-orbit satellite constellations that will offer various narrow- to wide-band wireless communications services will require phased-array antennas that feature wide-angle and superagile electronic steering of one or more antenna beams. Antennas, which employ monolithic microwave integrated circuits (MMIC), are perfectly suited for this application. Under a cooperative agreement, an MMIC-based, K-band phased-array antenna is being developed with 50/50 cost sharing by the NASA Lewis Research Center and Raytheon Systems Company. The transmitting array, which will operate at 19 gigahertz (GHz), is a state-of-the-art design that features dual, independent, electronically steerable beam operation (42), a stand-alone thermal management, and a high-density tile architecture. This array can transmit 622 megabits per second (Mbps) in each beam from Earth orbit to small Earth terminals. The weight of the total array package is expected to be less than 8 lb. The tile integration technology (flip chip MMIC tile) chosen for this

project represents a major advancement in phased-array engineering and holds much promise for reducing manufacturing costs.
Derived from text
Microwave Antennas; Satellite Communication; Antenna Arrays; Phased Arrays

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SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. 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 and Safety*.

20050187013 NASA Lewis Research Center, Cleveland, OH, USA
Cathodes Delivered for Space Station Plasma Contactor System
Patterson, Michael J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The International Space Station's (ISS) power system is designed with high-voltage solar arrays that typically operate at output voltages of 140 to 160 volts (V). The ISS grounding scheme electrically ties the habitat modules, structure, and radiators to the negative tap of the solar arrays. Without some active charge control method, this electrical configuration and the plasma current balance would cause the habitat modules, structure, and radiators to float to voltages as large as -120 V with respect to the ambient space plasma. With such large negative floating potentials, the ISS could have deleterious interactions with the space plasma. These interactions could include arcing through insulating surfaces and sputtering of conductive surfaces as ions are accelerated by the spacecraft plasma sheath. A plasma contactor system was baselined on the ISS to prevent arcing and sputtering. The sole requirement for the system is contained within a single directive (SSP 30000, paragraph 3.1.3.2.1.8): 'The Space Station structure floating potential at all points on the Space Station shall be controlled to within 40 V of the ionospheric plasma potential using a plasma contactor.' NASA is developing this plasma contactor as part of the ISS electrical power system. For ISS, efficient and rapid emission of high electron currents is required from the plasma contactor system under conditions of variable and uncertain current demand. A hollow cathode plasma source is well suited for this application and was, therefore, selected as the design approach for the station plasma contactor system. In addition to the plasma source, which is referred to as a hollow cathode assembly, or HCA, the plasma contactor system includes two other subsystems. These are the power electronics unit and the xenon gas feed system. The Rocketdyne Division of Boeing North American is responsible for the design, fabrication, assembly, test, and integration of the plasma contactor system. Because of technical and schedule considerations, the NASA Lewis Research Center was asked to manufacture and deliver the engineering model, the qualification model, and the flight HCA units for the plasma contactor system as government furnished equipment. To date, multiple units have been built. One cathode has demonstrated approximately 28 000-hr lifetime, two development HCA units have demonstrated over 15 000-hr lifetime, and one HCA unit has demonstrated more than 38 000 ignitions. All eight flight HCA's have been manufactured, acceptance tested, and are ready for delivery to the flight contractor.
Author
Cathodes; Solar Arrays; High Voltages; Contactors; Plasma Currents; Electric Potential

20050187022 NASA Lewis Research Center, Cleveland, OH, USA
International Low-Earth-Orbit Spacecraft Materials Test Program Initiated for Better Prediction of Durability and Performance
Rutledge, Sharon K.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Spacecraft in low Earth orbit (LEO) are subjected to many components of the environment, which can cause them to degrade much more rapidly than intended and greatly shorten their functional life. The atomic oxygen, ultraviolet radiation, and cross contamination present in LEO can affect sensitive surfaces such as thermal control paints, multilayer insulation, solar array surfaces, and optical surfaces. The LEO Spacecraft Materials Test (LEO-SMT) program is being conducted to assess the effects of simulated LEO exposure on current spacecraft materials to increase understanding of LEO degradation processes as well as to enable the prediction of in-space performance and durability. Using ground-based simulation facilities to test the durability of materials currently flying in LEO will allow researchers to compare the degradation evidenced in the

ground-based facilities with that evidenced on orbit. This will allow refinement of ground laboratory test systems and the development of algorithms to predict the durability and performance of new materials in LEO from ground test results. Accurate predictions based on ground tests could reduce development costs and increase reliability. The wide variety of national and international materials being tested represent materials being functionally used on spacecraft in LEO. The more varied the types of materials tested, the greater the probability that researchers will develop and validate predictive models for spacecraft long-term performance and durability. Organizations that are currently participating in the program are ITT Research Institute (USA), Lockheed Martin (USA), MAP (France), SOREQ Nuclear Research Center (Israel), TNO Institute of Applied Physics (The Netherlands), and UBE Industries, Ltd. (Japan). These represent some of the major suppliers of thermal control and sensor materials currently flying in LEO. The participants provide materials that are exposed to selected levels of atomic oxygen, vacuum ultraviolet radiation, contamination, or synergistic combined environments at the NASA Lewis Research Center. Changes in characteristics that could affect mission performance or lifetime are then measured. These characteristics include changes in mass, solar absorptance, and thermal emittance. The durability of spacecraft materials from U.S. suppliers is then compared with those of materials from other participating countries. Lewis will develop and validate performance and durability prediction models using this ground data and available space data. NASA welcomes the opportunity to consider additional international participants in this program, which should greatly aid future spacecraft designers as they select materials for LEO missions.
Author
Durability; Low Earth Orbits; Spacecraft Performance; Spacecraft Construction Materials

20050187023 NASA Lewis Research Center, Cleveland, OH, USA
Polymers Erosion and Contamination Experiment Being Developed
deGroh, Kim K.; Banks, Bruce A.; Barney-Barton, Elyse A.; Sechkar, Edward; Hunt, Patricia; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Polymers Erosion and Contamination Experiment (PEACE) is currently being developed at the NASA Lewis Research Center by the Electro-Physics Branch in conjunction with students and faculty from Hathaway Brown School in Cleveland. The experiment is a Get Away Special Canister shuttle flight experiment sponsored by the American Chemical Society. The two goals of this experiment are (1) to measure ram atomic oxygen erosion rates of approximately 40 polymers that have potential use in space applications and (2) to validate a method for identifying sources of silicone contamination that occur in the shuttle bay. Equipment to be used in this flight experiment is shown in the schematic diagram. Spacecraft materials subjected to attack by atomic oxygen in the space environment experience significant degradation over the span of a typical mission. Therefore, learning the rates of atomic oxygen erosion of a wide variety of polymers would be of great benefit to future missions. PEACE will use two independent techniques to determine the atomic oxygen erosion rates of polymers. Large (1-in.-diameter) samples will be used for obtaining mass loss. Preflight and postflight dehydrated masses will be obtained, and the mass lost during flight will be determined. Small (0.5-in.-diameter) samples will be protected with isolated particles (such as NaCl crystals) and then exposed to the space environment. After flight, the protective particles will be removed (washed off) and atomic force microscopy (AFM) will be used to measure the erosion depth from protected mesas. Erosion depth measurements are more sensitive than traditional mass measurements and are very useful for materials with low erosion yields or with very low fluence missions.
Author
Erosion; Contamination; Polymers; Degradation; Oxygen Atoms; Silicones

20050187091 NASA Lewis Research Center, Cleveland, OH, USA
Retrieval of Mir Solar Array
Rutledge, Sharon K.; deGroh, Kim K.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A Russian solar array panel removed in November 1997 from the non-articulating photovoltaic array on the Mir core module was returned to Earth on STS-89 in January 1998. The panel had been exposed to low Earth orbit (LEO) for 10 years prior to retrieval. The retrieval provided a unique opportunity to study the effects of the LEO environment on a functional solar array. To take advantage of this opportunity, a team composed of members from RSC-Energia (Russia), the Boeing Company, and the following NASA Centers--Johnson Space Center, Kennedy Space Center, Langley Research Center, Marshall Space Flight Center, and Lewis Research Center--was put together to analyze the array. After post-retrieval inspections at the Spacehab Facility at Kennedy in Florida, the array was shipped to Lewis in Cleveland for electrical performance tests, closeup photodocumentation, and removal of selected solar cells and blanket material. With approval from RSC-Energia, five cell pairs and their accompanying blanket and mesh material, and samples of painted handrail materials were selected for removal on

the basis of their ability to provide degradation information. Sites were selected that provided different sizes and shapes of micrometeoroid impacts and different levels of surface contamination. These materials were then distributed among the team for round robin testing.
Derived from text
Contamination; Degradation; Earth Orbital Environments; Environmental Tests; Photovoltaic Cells; Solar Arrays

20050188515 NASA Lewis Research Center, Cleveland, OH, USA
Silicon-Germanium Fast Packet Switch Developed for Communications Satellites
Quintana, Jorge A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Emerging multimedia applications and future satellite systems will require high-speed switching networks to accommodate high data-rate traffic among thousands of potential users. This will require advanced switching devices to enable communication between satellites. The NASA Lewis Research Center has been working closely with industry to develop a state-of-the-art fast packet switch (FPS) to fulfill this requirement. Recently, the Satellite Industry Task Force identified the need for high-capacity onboard processing switching components as one of the 'grand challenges' for the satellite industry in the 21st century. In response to this challenge, future generations of onboard processing satellites will require low power and low mass components to enable transmission of services in the 100 gigabit (1011 bits) per second (Gbps) range.
Derived from text
Communication Satellites; Germanium; Packet Switching; Silicon

20050188547 NASA Lewis Research Center, Cleveland, OH, USA
Stability of the Tilt Modes of an Actively Controlled Flywheel Analyzed
Brown, Gerald V.; Kascak, Albert F.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Applications of strongly gyroscopic rotors are becoming important, including flywheels for terrestrial and space energy storage and various attitude control devices for spacecraft. Some of these applications, especially the higher speed ones for energy storage, will have actively controlled magnetic bearings. These bearings will be required where speeds are too high for conventional bearings, where adequate lubrication is undesirable or impossible, or where bearing losses must be minimized for efficient energy storage. Flywheel rotors are highly gyroscopic, and above some speed that depends on the bandwidth of the feedback system, they always become unstable in an actively controlled magnetic bearing system. To assess ways to prevent instability until speeds well above the desired operating range, researchers at the NASA Lewis Research Center used a commercial controls code to calculate the eigenvalues of the tilt modes of a rigid gyroscopic rotor supported by active magnetic bearings. The real part of the eigenvalue is the negative of the damping of the mode, and the imaginary part is approximately equal to the mode s frequency.
Derived from text
Attitude (Inclination); Active Control; Flywheels

20050192117 NASA Lewis Research Center, Cleveland, OH, USA, Modern Technologies Corp., USA
NASA Lewis Thermal Barrier Feasibility Investigated for Use in Space Shuttle Solid-Rocket Motor Nozzle-to-Case Joints
Steinetz, Bruce M.; Dunlap, Patrick H., Jr.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Assembly joints of modern solid-rocket motor cases are usually sealed with conventional O-ring seals. The 5500 F combustion gases produced by rocket motors are kept a safe distance away from the seals by thick layers of insulation and by special compounds that fill assembly split-lines in the insulation. On limited occasions, NASA has observed charring of the primary O-rings of the space shuttle solid-rocket nozzle-assembly joints due to parasitic leakage paths opening up in the gap-fill compounds during rocket operation. Thus, solid-rocket motor manufacturer Thiokol approached the NASA Lewis Research Center about the possibility of applying Lewis braided-fiber preform seal as a thermal barrier to protect the O-ring seals. This thermal barrier would be placed upstream of the primary O-rings in the nozzle-to-case joints to prevent hot gases from impinging on the O-ring seals (see the following illustration). The illustration also shows joints 1 through 5, which are potential sites where the thermal barrier could be used.
Derived from text
Thermal Absorption; Barrier Layers; O Ring Seals; Leakage; Feasibility; Combustion Products

20050192123 NASA Lewis Research Center, Cleveland, OH, USA

DARTFire Sees Microgravity Fires in a New Light--Large Data Base of Images Obtained

Olson, Sandra L.; Hegde, Uday; Altenkirch, Robert A.; Bhatacharjee, Subrata; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The recently completed DARTFire sounding rocket microgravity combustion experiment launched a new era in the imaging of flames in microgravity. DARTFire stands for 'Diffusive and Radiative Transport in Fires,' which perfectly describes the two primary variables--diffusive flow and radiation effects--that were studied in the four launches of this program (June 1996 to September 1997). During each launch, two experiments, which were conducted simultaneously during the 6 min of microgravity, obtained results as the rocket briefly exited the Earth s atmosphere.

Derived from text

Combustion; Diffusivity; Fires; Gravitational Effects; Sounding Rockets

20050192344 NASA Glenn Research Center, Cleveland, OH, USA

Insights Developed Into the Damage Mechanism of Teflon FEP Thermal Control Material on the Hubble Space Telescope

deGroh, Kim K.; Gaier, James R.; Hall, Rachelle L.; Norris, mary Jo; Espe, Matthew P.; Cato, Daveen R.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Metalized Teflon FEP (DuPont; fluorinated ethylene propylene) thermal control material on the Hubble Space Telescope (HST) has been found to degrade in the space environment. Teflon FEP thermal control blankets retrieved during the first servicing mission were found to be embrittled on solar-facing surfaces and to contain microscopic cracks (the FEP surface is exposed to the space environment). During the second servicing mission, astronauts noticed that the FEP outer layer of the multilayer insulation blanketing covering the telescope was cracked in many locations. Large cracks were observed on the light shield, forward shell, and equipment bays. A tightly curled piece of cracked FEP from the light shield was retrieved during the second mission. This piece was severely embrittled, as witnessed by ground testing. A Failure Review Board was organized by NASA Goddard Space Flight Center to determine the mechanism causing the multilayer insulation degradation. This board included members of the Electro-Physics Branch of the NASA Glenn Research Center at Lewis Field. Density measurements of the retrieved materials obtained under the review board's investigations indicated that FEP from the first servicing mission was essentially unchanged from pristine FEP but that the second servicing mission FEP had increased in density in comparison to pristine FEP (ref. 1). The results were consistent with crystallinity measurements taken using x-ray diffraction and with results from solid-state nuclear magnetic resonance tests (see the table and ref. 1). Because the second servicing mission FEP was embrittled and its density and crystallinity had increased in comparison to pristine FEP, board researchers expected that the first servicing mission FEP, which was also embrittled, would also have increased in crystallinity and density, but it did not. Because the retrieved second servicing mission material curled while in space, it experienced a higher temperature extreme during thermal cycling (estimated at 200 C) than the first servicing mission material (estimated at 50 C). Therefore, Glenn initiated and conducted an investigation of the effects of heating pristine FEP and FEP that had been exposed on the Hubble Space Telescope. Samples of pristine and first and second servicing mission FEP were heated to 200 C and evaluated for changes in density and morphology. We hoped that the results would help explain why FEP degrades in the Hubble Space Telescope space environment.

Author

Damage; Temperature Control; Hubble Space Telescope; Metallizing; Density Measurement; Degradation

20050192347 NASA Glenn Research Center, Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA

Steady-State Vacuum Ultraviolet Exposure Facility With Automated Lamp Calibration and Sample Positioning Fabricated

Sechkar, Edward A.; Steuber, Thomas J.; Banks, Bruce A.; Dever, Joyce A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Next Generation Space Telescope (NGST) will be placed in an orbit that will subject it to constant solar radiation during its planned 10-year mission. A sunshield will be necessary to passively cool the telescope, protecting it from the Sun s energy and assuring proper operating temperatures for the telescope s instruments. This sunshield will be composed of metalized polymer multilayer insulation with an outer polymer membrane (12 to 25 mm in thickness) that will be metalized on the back to assure maximum reflectance of sunlight. The sunshield must maintain mechanical integrity and optical properties for the full 10 years. This durability requirement is most challenging for the outermost, constantly solar-facing polymer membrane of the sunshield. One of the potential threats to the membrane material s durability is from vacuum ultraviolet (VUV) radiation in wavelengths below 200 nm. Such radiation can be absorbed in the bulk of these thin polymer

membrane materials and degrade the polymer s optical and mechanical properties. So that a suitable membrane material can be selected that demonstrates durability to solar VUV radiation, ground-based testing of candidate materials must be conducted to simulate the total 10- year VUV exposure expected during the Next Generation Space Telescope mission. The Steady State Vacuum Ultraviolet exposure facility was designed and fabricated at the NASA Glenn Research Center at Lewis Field to provide unattended 24-hr exposure of candidate materials to VUV radiation of 3 to 5 times the Sun s intensity in the wavelength range of 115 to 200 nm. The facility s chamber, which maintains a pressure of approximately 5 10(exp -6) torr, is divided into three individual exposure cells, each with a separate VUV source and sample-positioning mechanism. The three test cells are separated by a water-cooled copper shield plate assembly to minimize thermal effects from adjacent test cells. Part of the interior sample positioning mechanism of one test cell is shown in the illustration. Of primary concern in VUV exposure is the maintenance of constant measured radiation intensity so that the sample s total exposure can be determined in equivalent Sun hours. This is complicated by the fact that a VUV lamp s intensity degrades over time, necessitating a decrease in the distance between the test samples and the lamp. The facility overcomes this challenge by periodically measuring the lamp s intensity with a cesium-iodide phototube and adjusting the sample distance as required to maintain constant exposure intensity. Sample positioning and periodic phototube location under the lamp are both achieved by a single lead-screw assembly. The lamps can be isolated from the main vacuum chamber for cleaning or replacement so that samples are not exposed to the atmosphere during a test.
Author
Telescopes; Solar Radiation; Temperature Effects; Multilayer Insulation; Cesium Iodides

20050192348 NASA Glenn Research Center, Cleveland, OH, USA
Environmental Exposure Conditions for Teflon FEP on the Hubble Space Telescope Investigated
Dever, Joyce A.; deGroh, Kim K.; Banks, Bruce A.; Townsend, Jacqueline a.; Barth, Janet L.; Thomson, Shaun; Gregory, Teri; Savage, William J.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Hubble Space Telescope (HST) was launched into low Earth orbit on April 24,1990. During the first servicing mission in December 1993 (3.6 years after launch), multilayer insulation (MLI) blankets were retrieved from the two magnetic sensing systems located on the light shield. Retrieval of one of the solar arrays during this mission also provided MLI blanket material from the solar array drive arm. These MLI materials were analyzed in ground-based facilities, and results indicate that the space-facing outer layer of the MLI, aluminized Teflon FEP (DuPont; fluorinated ethylene propylene), was beginning to degrade. Close inspection of the FEP revealed through-the-thickness cracks in areas with the highest solar exposure and stress concentration. During the second servicing mission in February 1997 (6.8 years after launch), astronauts observed and documented severe cracking in the outer layer of the MLI blankets on both the solar-facing and anti-solar-facing surfaces. During this second mission, some material from the outer layer of the light shield MLI was retrieved and subsequently analyzed in ground-based facilities. After the second servicing mission, a Failure Review Board was convened by NASA Goddard Space Flight Center to address the MLI degradation problem on HST. Members of the Electro-Physics Branch of the NASA Glenn Research Center at Lewis Field participated on this board. To determine possible degradation mechanisms, board researchers needed to consider all environmental constituents to which the FEP MLI surfaces were exposed. On the basis of measurements, models, and predictions, environmental exposure conditions for FEP surfaces on HST were estimated for various time periods from launch in 1990 through 2010, the planned end-of-life for HST. The table summarizes these data including the number and temperature ranges of thermal cycles; equivalent Sun hours; fluence and absorbed radiation dose from solar event x rays; fluence and absorbed dose from solar wind protons and electrons trapped in Earth s magnetic field; fluence of plasma electrons and protons; and atomic oxygen fluence.
Author
Hubble Space Telescope; Low Earth Orbits; Multilayer Insulation; Solar Arrays; Detection

20050192366 NASA Glenn Research Center, Cleveland, OH, USA
ACTS High-Speed VSAT Demonstrated
Tran, Quang K.; Research and Technology 1999; March 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Advanced Communication Technology Satellite (ACTS) developed by NASA has demonstrated the breakthrough technologies of Ka-band transmission, spot-beam antennas, and onboard processing. These technologies have enabled the development of very small and ultrasmall aperture terminals (VSAT s and USAT's), which have capabilities greater than have been possible with conventional satellite technologies. The ACTS High Speed VSAT (HS VSAT) is an effort at the NASA Glenn Research Center at Lewis Field to experimentally demonstrate the maximum user throughput data rate that can be achieved using the technologies developed and implemented on ACTS. This was done by operating the system uplinks as

frequency division multiple access (FDMA), essentially assigning all available time division multiple access (TDMA) time slots to a single user on each of two uplink frequencies. Preliminary results show that, using a 1.2-m antenna in this mode, the High Speed VSAT can achieve between 22 and 24 Mbps of the 27.5 Mbps burst rate, for a throughput efficiency of 80 to 88 percent.
Derived from text
VSAT (Network); ACTS

20050192396 NASA Glenn Research Center, Cleveland, OH, USA
Monte Carlo Technique Used to Model the Degradation of Internal Spacecraft Surfaces by Atomic Oxygen
Banks, Bruce A.; Miller, Sharon K.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Atomic oxygen is one of the predominant constituents of Earth's upper atmosphere. It is created by the photodissociation of molecular oxygen (O2) into single O atoms by ultraviolet radiation. It is chemically very reactive because a single O atom readily combines with another O atom or with other atoms or molecules that can form a stable oxide. The effects of atomic oxygen on the external surfaces of spacecraft in low Earth orbit can have dire consequences for spacecraft life, and this is a well-known and much studied problem. Much less information is known about the effects of atomic oxygen on the internal surfaces of spacecraft. This degradation can occur when openings in components of the spacecraft exterior exist that allow the entry of atomic oxygen into regions that may not have direct atomic oxygen attack but rather scattered attack. Openings can exist because of spacecraft venting, microwave cavities, and apertures for Earth viewing, Sun sensors, or star trackers. The effects of atomic oxygen erosion of polymers interior to an aperture on a spacecraft were simulated at the NASA Glenn Research Center by using Monte Carlo computational techniques. A two-dimensional model was used to provide quantitative indications of the attenuation of atomic oxygen flux as a function of the distance into a parallel-walled cavity. The model allows the atomic oxygen arrival direction, the Maxwell Boltzman temperature, and the ram energy to be varied along with the interaction parameters of the degree of recombination upon impact with polymer or nonreactive surfaces, the initial reaction probability, the reaction probability dependence upon energy and angle of attack, degree of specularity of scattering of reactive and nonreactive surfaces, and the degree of thermal accommodation upon impact with reactive and non-reactive surfaces to be varied to allow the model to produce atomic oxygen erosion geometries that replicate actual experimental results from space. The degree of erosion of various interior locations was compared with the erosion that would occur external to the spacecraft. Results of one cavity model indicate that, at depths into a two-dimensional cavity that are equal to 10 cavity widths, the erosion on the walls of the cavity is less than that on the top surface by over 2 orders of magnitude. Wall erosion near the surface of a cavity depends on which wall is receiving direct atomic oxygen attack. However, deep in the cavity little difference is present. Testing of various cavity models such as these gives spacecraft designers an indication of the level of threat to sensitive interior surfaces for different geometries. Even though the Monte Carlo model is two-dimensional, it can be used to provide qualitative information about spacecraft openings that are three-dimensional by offering reasonable insight as to the nature of the attenuation of damage that occurs within a spacecraft in low Earth orbit. As shown, there is more erosion on the side seeing direct atomic oxygen attack until a depth of approximately 5 times the width of the opening, where the erosion is the same on both sides.
Author
Degradation; Monte Carlo Method; Oxygen Atoms; Mathematical Models; Apertures; Spacecraft Design

20050192461 NASA Langley Research Center, Hampton, VA, USA
Structural Analysis of an Inflation-Deployed Solar Sail With Experimental Validation
Sleight, David W.; Michii, Yuki; Lichodziejewski, David; Derbes, Billy; Mann, Troy O.; [2005]; 15 pp.; In English; 41st AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 10-13 Jul. 2005, Tucson, AZ, USA
Contract(s)/Grant(s): 23-800-92-62
Report No.(s): AIAA Paper 2005-3727; Copyright; Avail: CASI; A03, Hardcopy

Under the direction of the NASA In-Space Propulsion Technology Office, the team of L Garde, NASA Jet Propulsion Laboratory, Ball Aerospace, and NASA Langley Research Center has been developing a scalable solar sail configuration to address NASA s future space propulsion needs. Prior to a flight experiment of a full-scale solar sail, a comprehensive phased test plan is currently being implemented to advance the technology readiness level of the solar sail design. These tests consist of solar sail component, subsystem, and sub-scale system ground tests that simulate the vacuum and thermal conditions of the space environment. Recently, two solar sail test articles, a 7.4-m beam assembly subsystem test article and a 10-m four-quadrant solar sail system test article, were tested in vacuum conditions with a gravity-offload system to mitigate the effects of gravity. This paper presents the structural analyses simulating the ground tests and the correlation of the analyses

with the test results. For programmatic risk reduction, a two-prong analysis approach was undertaken in which two separate teams independently developed computational models of the solar sail test articles using the finite element analysis software packages: NEiNastran and ABAQUS. This paper compares the pre-test and post-test analysis predictions from both software packages with the test data including load-deflection curves from static load tests, and vibration frequencies and mode shapes from structural dynamics tests. The analysis predictions were in reasonable agreement with the test data. Factors that precluded better correlation of the analyses and the tests were uncertainties in the material properties, test conditions, and modeling assumptions used in the analyses.
Author
Inflatable Structures; Solar Sails; Dynamic Structural Analysis; Applications Programs (Computers)

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SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

20050186935 National Inst. of Information and Communications Technology, Tokyo, Japan
Calibration Experiment of All-sky Electrostatic Analyzer
Miyake, Wataru; Yamazaki, Atsushi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 177-191; In English; See also 20050186915; Copyright; Avail: Other Sources

Electrostatic analyzers have been widely used for measuring the energy and incident angle distribution of space plasma on board the spacecraft. The measurement enables us to derive the flow velocity, density, and temperature of plasma, to detect the large-scale disturbances in space, and to forecast the space weather. An electrostatic analyzer with all-sky field of view has been developed for the L5 mission and the prototype model is calibrated by a ground facility. The results demonstrate a fair agreement with the numerical model calculations and its capability of the space plasma measurement on board 3-axis stabilized spacecraft such as the L5 mission.
Author
Calibrating; Electrostatic Probes; Space Plasmas; Spacecraft Instruments

20050188505 NASA Lewis Research Center, Cleveland, OH, USA
Novel Low-Cost, Low-Power Miniature Thermionic Cathode Developed for Microwave/Millimeter Wave Tube and Cathode Ray Tube Applications
Wintucky, Edwin G.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A low cost, small size and mass, low heater power, durable high-performance barium dispenser thermionic cathode has been developed that offers significant advancements in the design, manufacture, and performance of the electron sources used in vacuum electronic devices--such as microwave (and millimeter wave) traveling-wave tubes (TWT's)--and in display devices such as high-brightness, high-resolution cathode ray tubes (CRT's). The lower cathode heater power and the reduced size and mass of the new cathode are expected to be especially beneficial in TWT's for deep space communications, where future missions are requiring smaller spacecraft, higher data transfer rates (higher frequencies and radiofrequency output power), and greater electrical efficiency. Also expected to benefit are TWT's for commercial and government communication satellites, for both low and geosynchronous Earth orbit, with additional benefits offered by lower cost and potentially higher cathode current loading. A particularly important TWT application is in the microwave power module (MPM), which is a hybrid microwave (or millimeter wave) amplifier consisting of a low-noise solid state driver, a vacuum power booster (small TWT), and an electronic power conditioner integrated into a single compact package. The attributes of compactness and potentially high electrical efficiency make the MPM very attractive for many commercial and government (civilian and defense) applications in communication and radar systems. The MPM is already finding application in defense electronic systems and is under development by NASA for deep space communications. However, for the MPM to become competitive

and commercially successful, a major reduction in cost must be achieved.
Derived from text
Cathodes; Cathode Ray Tubes; Millimeter Waves; Microwaves; Space Communication; Thermionic Cathodes; Traveling Wave Tubes; Tube Cathodes

20050192406 NASA Glenn Research Center, Cleveland, OH, USA, Stirling Technology Co., USA
Adaptive Vibration Reduction System Shown to Effectively Eliminate Vibrations for the Stirling Radioisotope Power System
Thieme, Lanny G.; Research and Technology 1999; March 1, 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Stirling Technology Company (STC), as part of a Small Business Innovation Research contract Phase II with the NASA Glenn Research Center at Lewis Field, is developing an Adaptive Vibration Reduction System (AVRS) that will effectively eliminate vibrations for the Stirling radioisotope power system. The AVRS will reduce vibration levels for two synchronized, opposed Stirling converters by a factor of 10 or more under normal operating conditions. Even more importantly, the AVRS will be adaptive and will be able to adjust to any changing converter conditions over the course of a mission. The Stirling converter is being developed by NASA and the Department of Energy (DOE) as a high-efficiency option for a radioisotope power system to provide onboard electric power for NASA deep space missions. The high Stirling efficiency of over 25 percent for this application will reduce the required amount of isotope by more than a factor of 3 in comparison to the current radioisotope thermoelectric generators (RTG s). Stirling is the most developed converter option of the advanced power technologies under consideration.
Author
Vibration Damping; Radioisotope Batteries; Thermoelectric Generators; Stirling Cycle; Vibration

20050192411 NASA Glenn Research Center, Cleveland, OH, USA, Case Western Reserve Univ., USA
Hydrogen Sensors Demonstrated on the Shuttle
Hunter, Gary W.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Microelectromechanical-systems- (MEMS-) based hydrogen sensor technology developed by the NASA Glenn Research Center at Lewis Field and Case Western Reserve University was demonstrated on shuttle missions STS-95 (Senator Glenn s mission) and STS-96. These smart sensors, commercialized by Makel Engineering Inc., were part of an 'Integrated Vehicle Health Monitoring HEDS Technology Demonstration' series conducted at the NASA Kennedy Space Center. The experiments were designed to demonstrate the effect of technological upgrades on shuttle performance. The hydrogen sensors were micro-fabricated for minimal size, weight, and power consumption. A temperature detector and heater were included on the sensor for temperature control. Two palladium chrome (PdCr) hydrogen detection devices were included in each sensor package: a Schottky diode for low concentrations and a resistor for high concentrations. These sensor designs allow operation in inert environments. 'Smart' electronics developed by Makel Engineering were integrated with the sensors to control the sensor temperature and process the output of the various sensors. This complete hydrogen detection system (two sensors on a chip with smart electronics) flew on STS-95 (launched October 1998) and STS-96 (launched May 1999). It was installed in the aft compartment of the shuttle and used to monitor the hydrogen concentration in that region. Up to this time, a mass spectrometer had monitored the hydrogen concentration in the aft compartment before launch, and 'grab' bottles had been used after launch. The inside of these bottles is at vacuum. During flight, the grab bottles are pyrotechnically opened for a brief period, and the gas in the aft compartment is captured in the bottle. Several of these bottles are opened at different times during takeoff, and their contents are used to determine the time profile of the gases in the aft chamber. However, this information is not available until after the flight. On the launch pad, results from the new sensor technology paralleled the responses of the mass spectrometer with, in some cases, a quicker response time. In flight, data from the new sensors agreed with those derived from analyzing the contents of the grab bottles. Moreover, this microsensor can monitor the aft compartment continuously and, in principle, could monitor the health of the vehicle in real time during flight.
Author
Gas Detectors; Microelectromechanical Systems; Microinstrumentation; Space Shuttle Missions; Hydrogen; Spacecraft Performance; Systems-on-a-Chip; Temperature Control

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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, 15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

20050186896 NASA Glenn Research Center, Cleveland, OH, USA

Design and Off-Design Performance of 100 kWe-Class Brayton Power Conversion Systems

Johnson, Paul K.; Mason, Lee S.; June 2005; 22 pp.; In English; Space Technology and Applications International Forum, 13-17 Feb. 2005, Albuquerque, NM, USA

Contract(s)/Grant(s): NAS3-00145; WBS 22-982-10-03

Report No.(s): NASA/TM-2005-213626; E-15110; No Copyright; Avail: CASI; A03, Hardcopy

The NASA Glenn Research Center in-house computer model Closed Cycle Engine Program (CCEP) was used to explore the design trade space and off-design performance characteristics of 100 kWe-class recuperated Closed Brayton Cycle (CBC) power conversion systems. Input variables for a potential design point included the number of operating units (1, 2, 4), cycle peak pressure (0.5, 1, 2 MPa), and turbo-alternator shaft speed (30, 45, 60 kRPM). The design point analysis assumed a fixed turbine inlet temperature (1150 K), compressor inlet temperature (400 K), helium-xenon working-fluid molecular weight (40 g/mol), compressor pressure ratio (2.0), recuperator effectiveness (0.95), and a Sodium-Potassium (NaK) pumped-loop radiator. The design point options were compared on the basis of thermal input power, radiator area, and mass. For a nominal design point with defined Brayton components and radiator area, off-design cases were examined by reducing turbine inlet temperature (as low as 900 K), reducing shaft speed (as low as 50 percent of nominal), and circulating a percentage (up to 20 percent) of the compressor exit flow back to the gas cooler. The off-design examination sought approaches to reduce thermal input power without freezing the radiator.

Author

Brayton Cycle; Nuclear Electric Power Generation; Closed Cycles; Spacecraft Power Supplies; Heat Sinks

20050186905 NASA Glenn Research Center, Cleveland, OH, USA

Transport of Sputtered Carbon During Ground-Based Life Testing of Ion Thrusters

Marker, Colin L.; Clemons, Lucas A.; Banks, Bruce A.; Miller, Sharon; Snyder, Aaron; Hung, Ching-Cheh; Karniotis, Christina A.; Waters, Deborah L.; June 2005; 15 pp.; In English; Joint Propulsion Conference, 10-13 Jul. 2005, Tuscon, AZ, USA

Report No.(s): NASA/TM-2005-213798; AIAA Paper 2005-4413; E-15156; No Copyright; Avail: CASI; A03, Hardcopy

High voltage, high power electron bombardment ion thrusters needed for deep space missions will be required to be operated for long durations in space as well as during ground laboratory life testing. Carbon based ion optics are being considered for such thrusters. The sputter deposition of carbon and arc vaporized carbon flakes from long duration operation of ion thrusters can result in deposition on insulating surfaces, causing them to become conducting. Because the sticking coefficient is less than one, secondary deposition needs to be considered to assure that shorting of critical components does not occur. The sticking coefficient for sputtered carbon and arc vaporized carbon is measured as well as directional ejection distribution data for carbon that does not stick upon first impact.

Author

Ion Engines; Sputtering; Electron Bombardment; Vaporizing; Ion Optics; High Voltages

20050187014 NASA Lewis Research Center, Cleveland, OH, USA

High-Performance Bipropellant Engine

Biaglow, James A.; Schneider, Steven J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

TRW, under contract to the NASA Lewis Research Center, has successfully completed over 10 000 sec of testing of a rhenium thrust chamber manufactured via a new-generation powder metallurgy. High performance was achieved for two different propellants, N2O4- N2H4 and N2O4 -MMH. TRW conducted 44 tests with N2O4-N2H4, accumulating 5230 sec of operating time with maximum burn times of 600 sec and a specific impulse Isp of 333 sec. Seventeen tests were conducted with N2O4-MMH for an additional 4789 sec and a maximum Isp of 324 sec, with a maximum firing duration of 700 sec. Together, the 61 tests totalled 10 019 sec of operating time, with the chamber remaining in excellent condition. Of these tests, 11 lasted 600 to 700 sec. The performance of radiation-cooled rocket engines is limited by their operating temperature. For the past two to three decades, the majority of radiation-cooled rockets were composed of a high-temperature niobium alloy

(C103) with a disilicide oxide coating (R512) for oxidation resistance. The R512 coating practically limits the operating temperature to 1370 C. For the Earth-storable bipropellants commonly used in satellite and spacecraft propulsion systems, a significant amount of fuel film cooling is needed. The large film-cooling requirement extracts a large penalty in performance from incomplete mixing and combustion. A material system with a higher temperature capability has been matured to the point where engines are being readied for flight, particularly the 100-lb-thrust class engine. This system has powder rhenium (Re) as a substrate material with an iridium (Ir) oxidation-resistant coating. Again, the operating temperature is limited by the coating; however, Ir is capable of long-life operation at 2200 C. For Earth-storable bipropellants, this allows for the virtual elimination of fuel film cooling (some film cooling is used for thermal control of the head end). This has resulted in significant increases in specific impulse performance (15 to 20 sec). To determine the merits of a powder rhenium thrust chamber, Lewis On-Board Propulsion Branch directed TRW (under the Space Storable Rocket Technology Program and the High Pressure Earth Storable Rocket Technology Program) to design, fabricate, and test an engineering model to serve as a technology demonstrator.
Author
Powder Metallurgy; Thrust Chambers; Liquid Rocket Propellants; Rocket Engines; Nitrogen Tetroxide; Niobium Alloys; Heat Resistant Alloys

20050187015 NASA Lewis Research Center, Cleveland, OH, USA
Liquid Bipropellant Microrocket Concept Under Development
Schneider, Steven J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Fundamental research into the feasibility of microrockets for primary propulsion and attitude control for far-term micro/integrated spacecraft is being performed. These rockets would be fabricated using microelectrical and mechanical systems (MEMS) technology. The enabling technology is being developed at the Massachusetts Institute of Technology (MIT). The NASA/MIT program leverages a very large Army Research Office and Defense Advanced Research Projects Agency (DARPA) program for the development of microturbine technology. The microrocket motor is complete with regenerative cooling, turbopumps, and control valves etched onto the same chip. They would be fabricated in large numbers in parallel using semiconductor manufacturing techniques. The technology may lead to the development of microsatellites as fully integrated MEMS devices that could be mass produced at a fraction of the cost of current satellites.
Author
Microelectromechanical Systems; Microsatellites; Satellite Attitude Control; Microrocket Engines

20050187017 NASA Lewis Research Center, Cleveland, OH, USA
Ion Thruster and Power Processor Developed for the Deep Space 1 Mission
Sovey, James S.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Solar Electric Propulsion Technology Applications Readiness (NSTAR) Program has provided a single-string primary propulsion system to NASA's Deep Space 1 spacecraft. This spacecraft will carry about 81 kg of xenon propellant for the ion thruster, which can be throttled down from 2.3 to 0.5 kW as the spacecraft moves away from the Sun. The propellant load will provide about 20 months of propulsion at the one-half power throttle setpoint of 1.2 kW. This mission will validate the 2.5-kW ion propulsion system and will fly by the asteroid 1992 KD in 1999. If funding permits, Deep Space 1 also will encounter comets Wilson-Harrington and Borrelly in 2001. NASA Lewis Research Center's On-Board Propulsion Branch was responsible for the development of the 30-cm-diameter ion thruster, the 2.5-kW power processor unit (PPU), and the Digital Control and Interface Unit (DCIU) that controls the PPU/thruster/feed system and provides data and recovery from fault conditions. Lewis transferred the thruster and PPU technologies to the Hughes Electron Dynamics Division, which was selected to build two sets of flight thrusters, as well as the PPU's and DCIU's. Hughes subcontracted the DCIU development to Spectrum Astro Incorporated. The Jet Propulsion Laboratory (JPL) was primarily responsible for the NSTAR project management, thruster lifetests, the feed system, diagnostics, and the propulsion subsystem integration. A total of four engineering model thrusters and three breadboard PPU's were built, integrated, and tested. More than 50 development tests were conducted along with thruster design verification tests of 2000 and 1000 hours. In addition, an 8000-hr life demonstration test was successfully completed and demonstrated wear-rates consistent with full-power lifetimes in excess of 12,000 hours.
Author
Ion Engines; Xenon; Rocket Engine Control; Deep Space 1 Mission

20050187090 NASA Lewis Research Center, Cleveland, OH, USA
Power System Optimization Codes Modified
Juhasz, Albert J.; Research and Technology 1998; April 1999; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A major modification of and addition to existing Closed Brayton Cycle (CBC) space power system optimization codes was completed. These modifications relate to the global minimum mass search driver programs containing three nested iteration loops comprising iterations on cycle temperature ratio, and three separate pressure ratio iteration loops--one loop for maximizing thermodynamic efficiency, one for minimizing radiator area, and a final loop for minimizing overall power system mass. Using the method of steepest ascent, the code sweeps through the pressure ratio space repeatedly, each time with smaller iteration step sizes, so that the three optimum pressure ratios can be obtained to any desired accuracy for each of the objective functions referred to above (i.e., maximum thermodynamic efficiency, minimum radiator area, and minimum system mass). Two separate options for the power system heat source are available: 1. A nuclear fission reactor can be used. It is provided with a radiation shield 1. (composed of a lithium hydride (LiH) neutron shield and tungsten (W) gamma shield). Suboptions can be used to select the type of reactor (i.e., fast spectrum liquid metal cooled or epithermal high-temperature gas reactor (HTGR)). 2. A solar heat source can be used. This option includes a parabolic concentrator and heat receiver for raising the temperature of the recirculating working fluid. A useful feature of the code modifications is that key cycle parameters are displayed, including the overall system specific mass in kilograms per kilowatt and the system specific power in watts per kilogram, as the results for each temperature ratio are computed. As the minimum mass temperature ratio is encountered, a message is printed out. Several levels of detailed information on cycle state points, subsystem mass results, and radiator temperature profiles are stored for this temperature ratio condition and can be displayed or printed by users.
Author
Brayton Cycle; Closed Cycles; Power Supplies; Nuclear Fission; Solar Generators

20050188480 NASA Lewis Research Center, Cleveland, OH, USA
Parallel Stirling Converters Being Developed for Spacecraft Onboard Power
Thieme, Lanny G.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Stirling Technology Co., as part of a NASA Lewis Research Center Phase II Small Business Innovation Research contract, has successfully demonstrated paralleling two thermodynamically independent Stirling converters. A system of four Stirling converters is being developed by NASA and the Department of Energy as an alternative high-efficiency radioisotope power source for spacecraft onboard electric power for NASA deep space missions. The high Stirling efficiency, exceeding 20 percent for this application, will greatly reduce the necessary isotope inventory in comparison to the current radioisotope thermoelectric generators (RTG s), significantly reducing mission cost and risk. Stirling is the most developed converter option of the advanced power technologies under consideration.
Derived from text
Stirling Cycle; Power Converters; Thermoelectric Generators

20050188517 NASA Lewis Research Center, Cleveland, OH, USA
Use of Atomic Fuels for Rocket-Powered Launch Vehicles Analyzed
Palaszewski, Bryan A.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

At the NASA Lewis Research Center, the launch vehicle gross lift-off weight (GLOW) was analyzed for solid particle feed systems that use high-energy density atomic propellants (ref. 1). The analyses covered several propellant combinations, including atoms of aluminum, boron, carbon, and hydrogen stored in a solid cryogenic particle, with a cryogenic liquid as the carrier fluid. Several different weight percents for the liquid carrier were investigated, and the GLOW values of vehicles using the solid particle feed systems were compared with that of a conventional oxygen/hydrogen (O2/H2) propellant vehicle. Atomic propellants, such as boron, carbon, and hydrogen, have an enormous potential for high specific impulse Isp operation, and their pursuit has been a topic of great interest for decades. Recent and continuing advances in the understanding of matter, the development of new technologies for simulating matter at its most basic level, and manipulations of matter through microtechnology and nanotechnology will no doubt create a bright future for atomic propellants and an exciting one for the researchers exploring this technology.
Derived from text
Nuclear Propulsion; Propellants; Launch Vehicles; Rocket Vehicles

20050192129 NASA Lewis Research Center, Cleveland, OH, USA
Unlocking the Keys to Vortex/Flame Interactions in Turbulent Gas-Jet Diffusion Flames--Dynamic Behavior Explored on the Space Shuttle
Stocker, Dennis P.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Most combustion processes in industrial applications (e.g., furnaces and engines) and in nature (e.g., forest fires) are turbulent. A better understanding of turbulent combustion could lead to improved combustor design, with enhanced efficiency and reduced emissions. Despite its importance, turbulent combustion is poorly understood because of its complexity. The rapidly changing and random behavior of such flames currently prevents detailed analysis, whether experimentally or computationally. However, it is possible to learn about the fundamental behavior of turbulent flames by exploring the controlled interaction of steady laminar flames and artificially induced flow vortices. These interactions are an inherent part of turbulent flames, and understanding them is essential to the characterization of turbulent combustion. Well-controlled and defined experiments of vortex interaction with laminar flames are not possible in normal gravity because of the interference of buoyancy- (i.e., gravity) induced vortices. Therefore, a joint microgravity study was established by researchers from the Science and Technology Development Corp. and the NASA Lewis Research Center. The experimental study culminated in the conduct of the Turbulent Gas-Jet Diffusion Flames (TGDF) Experiment on the STS-87 space shuttle mission in November 1997. The fully automated hardware, shown in photo, was designed and built at Lewis. During the mission, the experiment was housed in a Get Away Special (GAS) canister in the cargo bay.
Author
Vortices; Flame Propagation; Turbulent Flames; Gas Jets; Dynamic Characteristics

20050192136 NASA Lewis Research Center, Cleveland, OH, USA
Effects of g-Jitter on Diffusion in Binary Liquids
Duval, Walter M. B.; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The microgravity environment offers the potential to measure the binary diffusion coefficients in liquids without the masking effects introduced by buoyancy-induced flows due to Earth s gravity. However, the background g-jitter (vibrations from the shuttle, onboard machinery, and crew) normally encountered in many shuttle experiments may alter the benefits of the microgravity environment and introduce vibrations that could offset its intrinsic advantages. An experiment during STS-85 (August 1997) used the Microgravity Vibration Isolation Mount (MIM) to isolate and introduce controlled vibrations to two miscible liquids inside a cavity to study the effects of g-jitter on liquid diffusion. Diffusion in a nonhomogeneous liquid system is caused by a nonequilibrium condition that results in the transport of mass (dispersion of the different kinds of liquid molecules) to approach equilibrium. The dynamic state of the system tends toward equilibrium such that the system becomes homogeneous. An everyday example is the mixing of cream and coffee (a nonhomogeneous system) via stirring. The cream diffuses into the coffee, thus forming a homogeneous system. At equilibrium the system is said to be mixed. However, during stirring, simple observations show complex flow field dynamics-stretching and folding of material interfaces, thinning of striation thickness, self-similar patterns, and so on. This example illustrates that, even though mixing occurs via mass diffusion, stirring to enhance transport plays a major role. Stirring can be induced either by mechanical means (spoon or plastic stirrer) or via buoyancy-induced forces caused by Earth s gravity. Accurate measurements of binary diffusion coefficients are often inhibited by buoyancy-induced flows. The microgravity environment minimizes the effect of buoyancy-induced flows and allows the true diffusion limit to be achieved. One goal of this experiment was to show that the microgravity environment suppresses buoyancy-induced convection, thereby mass diffusion becomes the dominant mechanism for transport. Since g-jitter transmitted by the shuttle to the experiment can potentially excite buoyancy-induced flows, we also studied the effects of controlled vibrations on the system.
Author
Diffusion Coefficient; Flow Distribution; Microgravity; Nonequilibrium Conditions

20050192202 NASA Glenn Research Center, Cleveland, OH, USA
Materials International Space Station Experiment (MISSE) 5 Developed to Test Advanced Solar Cell Technology Aboard the ISS
Wilt, David M.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The testing of new technologies aboard the International Space Station (ISS) is facilitated through the use of a passive experiment container, or PEC, developed at the NASA Langley Research Center. The PEC is an aluminum suitcase approximately 2 ft square and 5 in. thick. Inside the PEC are mounted Materials International Space Station Experiment (MISSE) plates that contain the test articles. The PEC is carried to the ISS aboard the space shuttle or a Russian resupply vehicle, where astronauts attach it to a handrail on the outer surface of the ISS and deploy the PEC, which is to say the suitcase is opened 180 deg. Typically, the PEC is left in this position for approximately 1 year, at which point astronauts close the PEC and it is returned to Earth. In the past, the PECs have contained passive experiments, principally designed to characterize the durability of materials subjected to the ultraviolet radiation and atomic oxygen present at the ISS orbit. The MISSE5

experiment is intended to characterize state-of-art (SOA) and beyond photovoltaic technologies.
Derived from text
Spacecraft Power Supplies; Solar Cells; Spaceborne Experiments; Performance Tests

20050192209 NASA Glenn Research Center, Cleveland, OH, USA
Testing Conducted for Lithium-Ion Cell and Battery Verification
Reid, Concha M.; Miller, Thomas B.; Manzo, Michelle A.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center has been conducting in-house testing in support of NASA's Lithium-Ion Cell Verification Test Program, which is evaluating the performance of lithium-ion cells and batteries for NASA mission operations. The test program is supported by NASA's Office of Aerospace Technology under the NASA Aerospace Flight Battery Systems Program, which serves to bridge the gap between the development of technology advances and the realization of these advances into mission applications. During fiscal year 2003, much of the in-house testing effort focused on the evaluation of a flight battery originally intended for use on the Mars Surveyor Program 2001 Lander. Results of this testing will be compared with the results for similar batteries being tested at the Jet Propulsion Laboratory, the Air Force Research Laboratory, and the Naval Research Laboratory. Ultimately, this work will be used to validate lithium-ion battery technology for future space missions. The Mars Surveyor Program 2001 Lander battery was characterized at several different voltages and temperatures before life-cycle testing was begun. During characterization, the battery displayed excellent capacity and efficiency characteristics across a range of temperatures and charge/discharge conditions. Currently, the battery is undergoing lifecycle testing at 0 C and 40-percent depth of discharge under low-Earth-orbit (LEO) conditions.
Author
Lithium Batteries; Spacecraft Power Supplies; Electric Equipment Tests; Space Environment Simulation

20050192211 NASA Glenn Research Center, Cleveland, OH, USA
High-Power Krypton Hall Thruster Technology Being Developed for Nuclear-Powered Applications
Jacobson, David T.; Manzella, David H.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center has been performing research and development of moderate specific impulse, xenon-fueled, high-power Hall thrusters for potential solar electric propulsion applications. These applications include Mars missions, reusable tugs for low-Earth-orbit to geosynchronous-Earth-orbit transportation, and missions that require transportation to libration points. This research and development effort resulted in the design and fabrication of the NASA-457M Hall thruster that has been tested at input powers up to 95 kW. During project year 2003, NASA established Project Prometheus to develop technology in the areas of nuclear power and propulsion, which are enabling for deep-space science missions. One of the Project-Prometheus-sponsored Nuclear Propulsion Research tasks is to investigate alternate propellants for high-power Hall thruster electric propulsion. The motivation for alternate propellants includes the disadvantageous cost and availability of xenon propellant for extremely large scale, xenon-fueled propulsion systems and the potential system performance benefits of using alternate propellants. The alternate propellant krypton was investigated because of its low cost relative to xenon. Krypton propellant also has potential performance benefits for deep-space missions because the theoretical specific impulse for a given voltage is 20 percent higher than for xenon because of krypton's lower molecular weight. During project year 2003, the performance of the high-power NASA-457M Hall thruster was measured using krypton as the propellant at power levels ranging from 6.4 to 72.5 kW. The thrust produced ranged from 0.3 to 2.5 N at a discharge specific impulse up to 4500 sec.
Derived from text
Hall Thrusters; Krypton

20050192218 NASA Glenn Research Center, Cleveland, OH, USA
Ion Thruster Power Levels Extended by a Factor of 10
Patterson, Michael J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In response to two NASA Office of Space Science initiatives, the NASA Glenn Research Center is now developing a 7-kW-class xenon ion thruster system for near-term solar-powered spacecraft and a 25-kW ion engine for nuclear-electric spacecraft. The 7-kW ion thruster and power processor can be throttled down to 1 kW and are applicable to 25-kW flagship missions to the outer planets, asteroids, and comets. This propulsion system was scaled up from the 2.5-kW ion thruster and

power processor that was developed successfully by Glenn, Boeing, the Jet Propulsion Laboratory (JPL), and Spectrum Astro for the Deep Space 1 spacecraft. The 7-kW ion thruster system is being developed under NASA's Evolutionary Xenon Thruster (NEXT) project, which includes partners from JPL, Aerojet, Boeing, the University of Michigan, and Colorado State University.
Author
Ion Engines; Xenon; Spacecraft Propulsion

20050192220 NASA Glenn Research Center, Cleveland, OH, USA
Lorentz Force Accelerator Technology Investigated
Pencil, Eric J.; LaPointe, Michael R.; Arrington, Lynn A.; Kamhawi, Hani; Benson, Scott W.; Hoskins, W. Andrew; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center is developing Lorenz force accelerators (LFAs) for a wide variety of space applications. These range from the precision control of formation-flying spacecraft to the primary propulsion system for very high power interplanetary spacecraft. The specific thruster technologies being addressed are pulsed plasma thrusters (PPT) and magnetoplasmadynamic (MPD) thrusters.
Derived from text
Lorentz Force; Magnetoplasmadynamic Thrusters; Pulsed Plasma Thrusters; Spacecraft Propulsion

20050192221 NASA Glenn Research Center, Cleveland, OH, USA
Multikilowatt Power Module Designed and Fabricated for High-Power Hall Thrusters
Pinero, Luis R.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Previous efforts to develop power processing units (PPUs) for Hall thruster systems were targeted for the 1- to 5-kW power range and an output voltage of approximately 300 V. The NASA Glenn Research Center is developing new high-power Hall thrusters with a favorable combination of thrust, specific impulse, and efficiency to enable Earth-orbiting and Mars missions. These thrusters require up to 100 kW of power and a discharge voltage in excess of 800 V.
Author
Spacecraft Power Supplies; Hall Thrusters; Spacecraft Electronic Equipment

20050192332 NASA Glenn Research Center, Cleveland, OH, USA
4.5-kW Hall Effect Thruster Evaluated
Mason, Lee S.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As part of an Interagency Agreement with the Air Force Research Lab (AFRL), a space simulation test of a Russian SPT 140 Hall Effect Thruster was completed in September 1999 at Vacuum Facility 6 at the NASA Glenn Research Center at Lewis Field. The thruster was subjected to a three-part test sequence that included thrust and performance characterization, electromagnetic interference, and plume contamination. SPT 140 is a 4.5-kW thruster developed under a joint agreement between AFRL, Atlantic Research Corp, and Space Systems/Loral, and was manufactured by the Fakal Experimental Design Bureau of Russia. All objectives were satisfied, and the thruster performed exceptionally well during the 120-hr test program, which comprised 33 engine firings. The Glenn testing provided a critical contribution to the thruster development effort, and the large volume and high pumping speed of this vacuum facility was key to the test s success. The low background pressure (1 10 6 torr) provided a more accurate representation of space vacuum than is possible in most vacuum chambers. The facility had been upgraded recently with new cryogenic pumps and sputter shielding to support the active electric propulsion program at Glenn. The Glenn test team was responsible for all test support equipment, including the thrust stand, power supplies, data acquisition, electromagnetic interference measurement equipment, and the contamination measurement system.
Derived from text
Hall Effect; Propulsion

20050192361 DYNACS Engineering Co., Inc., USA
Aerospike Engine Post-Test Diagnostic System Delivered to Rocketdyne
Meyer, Claudia M.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center at Lewis Field, in cooperation with Rocketdyne, has designed, developed, and implemented an automated Post-Test Diagnostic System (PTDS) for the X-33 linear aerospike engine. The PTDS was developed to reduce analysis time and to increase the accuracy and repeatability of rocket engine ground test fire and flight

data analysis. This diagnostic system provides a fast, consistent, first-pass data analysis, thereby aiding engineers who are responsible for detecting and diagnosing engine anomalies from sensor data. It uses analytical methods modeled after the analysis strategies used by engineers. Glenn delivered the first version of PTDS in September of 1998 to support testing of the engine s power pack assembly. The system was used to analyze all 17 power pack tests and assisted Rocketdyne engineers in troubleshooting both data acquisition and test article anomalies. The engine version of PTDS, which was delivered in June of 1999, will support all single-engine, dual-engine, and flight firings of the aerospike engine.
Derived from text
Aerospike Engines; Rocket Engines; Rocket Engine Design

20050192364 NASA Glenn Research Center, Cleveland, OH, USA, Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA, Moog, Inc., East Aurora, NY, USA, Spectrum Astro, Inc., USA
Ion Thruster Used to Propel the Deep Space 1 Spacecraft to Comet Encounters
Sovey, James S.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Solar Electric Propulsion Technology Applications Readiness (NSTAR) Project provided a xenon ion propulsion system to the Deep Space 1 (DS1) spacecraft to validate the propulsion system as well as perform primary propulsion for asteroid and comet encounters. The On-Board Propulsion Branch of the NASA Glenn Research Center at Lewis Field developed engineering model versions of the 30-cm-diameter ion thruster and the 2.5-kW power processor unit (PPU). Glenn then transferred the thruster and PPU technologies to Hughes Electron Dynamics and managed the contract, which supplied two flight sets of thrusters and PPU s to the Deep Space 1 spacecraft and to a ground-based life verification test at the Jet Propulsion Laboratory (JPL). In addition to managing the DS1 spacecraft development, JPL was responsible for the NSTAR Project management, thruster life tests, the feed system, diagnostics, and propulsion subsystem integration. The ion propulsion development team included NASA Glenn, JPL, Hughes Electronics, Moog Inc., and Spectrum Astro Inc. The overall NSTAR subsystem dry mass, including thruster, PPU, controller, cables, and the xenon storage and feed system, is 48 kg. The mass of the xenon stored onboard DS1 was about 81 kg, and the spacecraft wet mass was approximately 500 kg.The DS1 spacecraft was launched on October 24, 1998, and on July 29, 1999, it flew within 16 miles of the small asteroid Braille (formerly 1992KD) at a relative speed of 35,000 mph. As of November 1999, the ion propulsion system had performed flawlessly for nearly 149 days of thrusting. NASA has approved an extension to the mission, which will allow DS1 to continue thrusting to encounters with two comets in 2001. The DS1 optical and plasma diagnostic instruments will be used to investigate the comet and space environments. The spacecraft is scheduled to fly past the dormant comet Wilson- Harrington in January 2001 and the very active comet Borrelly in September 2001, at which time approximately 500 days of ion engine thrusting will have been completed.
Author
Comets; Deep Space 1 Mission; Encounters; Solar Electric Propulsion; Ion Propulsion; Spacecraft Design

20050192370 NASA Glenn Research Center, Cleveland, OH, USA
Solid Hydrogen Formed for Atomic Propellants
Palaszewski, Bryan A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Several experiments on the formation of solid hydrogen particles in liquid helium were recently conducted at the NASA Glenn Research Center at Lewis Field. The solid hydrogen experiments are the first step toward seeing these particles and determining their shape and size. The particles will ultimately store atoms of boron, carbon, or hydrogen, forming an atomic propellant. Atomic propellants will allow rocket vehicles to carry payloads many times heavier than possible with existing rockets or allow them to be much smaller and lighter. Solid hydrogen particles are preferred for storing atoms. Hydrogen is generally an excellent fuel with a low molecular weight. Very low temperature hydrogen particles (T \h 4 K) can prevent the atoms from recombining, making it possible for their lifetime to be controlled. Also, particles that are less than 1 mm in diameter are preferred because they can flow easily into a pipe when suspended in liquid helium. The particles and atoms must remain at this low temperature until the fuel is introduced into the engine combustion (or recombination) chamber. Experiments were, therefore, planned to look at the particles and observe their formation and any changes while in liquid helium.
Derived from text
Hydrogen; Helium Atoms; Rocket Propellants; Propellants

20050192371 NASA Glenn Research Center, Cleveland, OH, USA

Atomic Rocket Vehicle Performance Improved

Palaszewski, Bryan A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center at Lewis Field conducted several analyses of atomic rocket propulsion systems (refs. 1 and 2). The atomic rocket engine performance and gross lift-off weight (GLOW) of several vehicle designs were used to describe the best atom loadings in rocket fuels. These best loadings will influence the vehicle dry mass, GLOW, and rocket pressurization system. Both monopropellant (fuel only with no oxidizer) and bipropellant (oxidizer and fuel) propulsion systems were assessed. The left graph provides the rocket s specific impulse Isp for a type of atomic boron rocket: 22-wt % atomic boron. These Isp values were computed with several helium loadings. The helium, added to the fuel mass, creates a gelled liquid to carry the atomic fuel to the rocket engine from its fuel tank. As the helium is added, the Isp values are reduced, but not so much that the rocket vehicle becomes impractical.

Derived from text

Nuclear Propulsion; Rocket Vehicles

20050192372 NASA Glenn Research Center, Cleveland, OH, USA

Extensive Testing Conducted for the Advanced Subsonics Technology Regional Engine Combustor Program

Penko, Paul F.; Research and Technology 1999; March 2000; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A substantial amount of testing was conducted in combustion facilities at the NASA Glenn Research Center at Lewis Field for the Advanced Subsonics Technology (AST) Regional Engine Program. Hardware was tested for three engine-manufacturing companies: General Electric, Rolls Royce-Allison, and AlliedSignal Aerospace. The hardware, which varied from single fuel-injector modules to three-cup sectors, was tested in Glenn's Engine Research Building CE5 test stands (Stand 1 and Stand 2) and in Glenn's large Advanced Subsonic Combustion Rig (ASCR). A three-cup sector was run in two separate test series for AlliedSignal in Stand 1of CE5, and a three-cup sector for Rolls Royce-Allison in the ASCR, all at engine-operating conditions. Measurement of pollutant emissions-NOx, CO, and unburned hydrocarbons-was the primary objective of the tests, along with a determination of combustion efficiency. The results have been used in the design of a full-annular combustor to be run at AlliedSignal. For Rolls Royce-Allison, single modules were run in Stand 1 for both pollutant emissions as well as laser measurement of the fuel spray by Phase Doppler Particle Analysis (PDPA) and location of the flame front by OH imaging. Also for Rolls Royce-Allison, an important milestone was reached with the successful test run of a three-cup sector in the ASCR in September. The test demonstrated that NOx emissions can be reduced by nearly 70 percent referred to the 1996 International Civil Aviation Organization (ICAO) Standards. For GE, single-fuel modules of a lean, direct injection (LDI) design by CFD Research Company (CFDRC) were run in Stand 2 of CE5, where emission and laser measurements were made. This capped a successful year that saw the timely completion of hardware testing for the three regional-engine AST contractors.

Author

Combustion Chambers; Combustion Efficiency; Propellants; Fuel Combustion

20050192395 NASA Glenn Research Center, Cleveland, OH, USA

Novel Vibration Damping of Ceramic Matrix Composite Turbine Blades Developed for RLV Applications

Min, James B.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Reusable Launch Vehicle (RLV) represents the next generation of space transportation for the U.S. space program. The goal for this vehicle is to lower launch costs by an order of magnitude from $10,000/lb to $1,000/lb. Such a large cost reduction will require a highly efficient operation, which naturally will require highly efficient engines. The RS-2200 Linear Aerospike Engine is being considered as the main powerplant for the RLV. Strong, lightweight, temperature-resistant ceramic matrix composite (CMC) materials such as C/SiC are critical to the development of the RS-2200. Preliminary engine designs subject turbopump components to extremely high frequency dynamic excitation, and ceramic matrix composite materials are typically lightly damped, making them vulnerable to high-cycle fatigue. The combination of low damping and high-frequency excitation creates the need for enhanced damping. Thus, the goal of this project has been to develop well-damped C/SiC turbine components for use in the RLV. Foster-Miller and Boeing Rocketdyne have been using an innovative, low-cost process to develop light, strong, highly damped turbopump components for the RS-2200 under NASA s Small Business Innovation Research (SBIR) program. The NASA Glenn Research Center at Lewis Field is managing this work. The process combines three-dimensionally braided fiber reinforcement with a pre-ceramic polymer. The three-dimensional reinforcement significantly improves the structure over conventional two-dimensional laminates, including high through-the-thickness strength and stiffness. Phase I of the project successfully applied the Foster-Miller pre-ceramic polymer infiltration and

pyrolysis (PIP) process to the manufacture of dynamic specimens representative of engine components. An important aspect of the program has been the development of the manufacturing process. Results show that the three-dimensionally braided carbon-fiber reinforcement provides good processability and good mechanical stiffness and strength in comparison to materials produced with competing processes as shown in the graphs.
Author
Vibration Damping; Ceramic Matrix Composites; Turbine Blades; Reusable Launch Vehicles

23
CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 25 through 29*. For astrochemistry see category *90 Astrophysics*.

20050186913 Defence Science and Technology Organisation, Fishermans Bend, Australia
The Chemical Resistance of Epoxy Adhesive Joints Exposed to Aviation Fuel and its Additives
Rider, Andrew; Yeo, Eudora; March 2005; 40 pp.; In English
Report No.(s): DSTO-TR-1650; DODA-AR-013-348; Copyright; Avail: Other Sources

Adhesively bonded structure and bonded composite repairs are often exposed to aviation fuel during service. A relatively limited number of studies examining the influence of fuel and the many additives it contains have been made. The current report details experimental studies that have examined the influence of fuel and common additives such as lubricity and deicing agents on the fracture toughness of metal and composite bonded adhesive joints. The studies aimed to determine if a series of reference fuels containing each of the additives may affect adhesive bond durability. Current results suggest that the bond durability of adhesive joints exposed for several thousands hours to fuel environments may reduce. Concentrated mixtures of water and deicing agent, which were prepared in order to simulate the environment in the bottom of fuel tanks, may also reduce joint fracture toughness. The present studies highlight the complexity of examining the influence of fuel environments on adhesive joints and the need for further research to more quantifiably assess possible mechanisms of bond degradation in typical aircraft operating environments.
Author
Adhesive Bonding; Aircraft Fuels; Deicing; Bonded Joints; Additives

20050187039 Duquesne Univ., Pittsburgh, PA, USA
Synthesis and Characterization of Advanced Magnetic Materials for the Grant entitled 'Laser Processing of Advanced Magnetic Materials.' Final Report, September 12, 2002-September 11, 2004
Sorescu, M.; Sep. 2004; 42 pp.; In English
Report No.(s): DE2005-837003; No Copyright; Avail: Department of Energy Information Bridge

The work described in this grant report was focused mainly on the properties of novel magnetic intermetallics. In the first project, we synthesized several 2:17 intermetallic compounds, namely Nd(sub 2)Fe(sub 15)Si(sub 2), Nd(sub 2)Fe(sub 15)Al(sub 2), Nd(sub 2)Fe(sub 15)SiAl and Nd(sub 2)Fe(sub 15)SiMn, as well as several 1:12 intermetallic compounds, such as NdFe(sub 10)Si(sub 2), NdFe(sub 10)Al(sub 2), NdFe(sub 10)SiAl and NdFe(sub 10)MnAl. In the second project, seven compositions of Nd(sub x)Fe(sub 100-x-y)B(sub y) ribbons were prepared by a melt spinning method with Nd and B content increasing from 7.3 and 3.6 to 11 and 6, respectively. The alloys were annealed under optimized conditions to obtain a composite material consisting of the hard magnetic Nd(sub 2)Fe(sub 14)B and soft magnetic (alpha)-Fe phases, typical of a spring magnet structure. In the third project, intermetallic compounds of the type Zr(sub 1)Cr(sub 1)Fe(sub 1)T(sub 0.8) with T = Al, Co and Fe were subjected to hydrogenation. In the fourth project, we performed three crucial experiments. In the first experiment, we subjected a mixture of Fe(sub 3)O(sub 4) and Fe (80-20 wt %) to mechanochemical activation by high-energy ball milling, for time periods ranging from 0.5 to 14 hours. In the second experiment, we ball-milled Fe(sub 3)O(sub 4):Co(sup 2+) (x = 0.1) for time intervals between 2.5 and 17.5 hours. Finally, we exposed a mixture of Fe(sub 3)O(sub 4) and Co (80-20 wt %) to mechanochemical activation for time periods ranging from 0.5 to 10 hours. In all cases, the structural and magnetic properties of the systems involved were elucidated by X-ray diffraction (XRD), Moessbauer spectroscopy and hysteresis loop measurements. The four projects resulted in four papers, which were published in Intermetallics, IEEE Transactions on Magnetics, Journal of Materials Science Letters and Materials Chemistry and Physics. The contributions reveal for the first time in literature the effect of substitutions on the hyperfine magnetic field of neodymium-based intermetallics, the correlation between structure and magnetic properties in spring magnets, the unique effects induced by hydrogenation on the hyperfine

parameters of iron-rich intermetallics and the characteristics of the ball milling process in systems containing magnetite.
NTIS
Intermetallics; Magnetic Materials

20050187088 Carnegie-Mellon Univ., Pittsburgh, PA, USA
Energetics of Solid/Solid and Liquid/Solid Interfaces
Oct. 2004; 12 pp.; In English
Report No.(s): DE2005-833421; No Copyright; Avail: Department of Energy Information Bridge

The main thrust of this research was to develop better understanding of the interfacial energetics of crystalline particles of one phase confined (or embedded) in matrices of another phase. Much of the work that motivated this research had been performed on Pb particles embedded in Al. Furthermore, significant contributions to that body of knowledge had emerged from collaborative work between Dr. U. Dahmen of the National Center for Electron Microscopy at LBNL and Prof. E. Johnson of the Neils Bohr Institute of the University of Copenhagen. Thus, the work performed under this Grant benefited from significant input into the design of the research from Dr. Dahmen and Prof. Johnson, who were officially listed as collaborators on the grant. Beyond interest in interfacial energies, there were several intriguing observations on Pb particles embedded in Al for which understanding was lacking. These included observations of large melting point elevation, or superheating, of embedded Pb particles. The melting temperature of these particles was found to increase with decreasing particle size, and to rise several tens of degrees above the bulk melting temperature for nano-scale particles. Since nucleation phenomena play an important role in melting and freezing, it was clear that the difficulties of interpreting superheating during melting could not readily be addressed without knowledge of the interfacial energies that enter into the formalism used to predict nucleation effects. The approaches taken in the studies included computer simulations, experimental studies and analytical modeling. Although about half of the work focused on Pb particles embedded in Al, other systems and issues were also addressed.
NTIS
Computerized Simulation; Liquid-Solid Interfaces; Melting; Nucleation

20050187101 South Carolina Univ., Columbia, SC, USA
Studies of the Transformations of Sulfur Containing Heterocycles by Transition Metal Cluster Compounds
Adams, R. D.; Oct. 1999; 24 pp.; In English
Report No.(s): DE2005-803362; No Copyright; Avail: Department of Energy Information Bridge

Report on results of research on the catalytic macrocyclization reactions of thietane and thiolactones by metal carbonyl complexes.
NTIS
Metal Clusters; Phase Transformations; Sulfur; Sulfur Compounds; Transition Metals

20050188487 NASA Lewis Research Center, Cleveland, OH, USA
Diamond Analyzed by Secondary Electron Emission Spectroscopy
Krainsky, Isay L.; Research and Technology 1998; April 1998; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Diamond is a promising semiconductor material for novel electronic applications because of its chemical stability and inertness, heat conduction properties, and so-called negative electron affinity (NEA). When a surface has NEA, electrons generated inside the bulk of the material are able to come out into the vacuum without any potential barrier (work function). Such a material would have an extremely high secondary electron emission coefficient o, very high photoelectron (quantum) yield, and would probably be an efficient field emitter. Chemical-vapor-deposited (CVD) polycrystalline diamond films have even more advantages than diamond single crystals. Their fabrication is relatively easy and inexpensive, and they can be grown with high levels of doping--consequently, they can have relatively high conductivity. Because of these properties, diamond can be used for cold cathodes and photocathodes in high-power electronics and in high-frequency and high-temperature semiconductor devices.
Derived from text
Diamonds; Electron Emission; Emission Spectra

20050189208 Environmental Monitoring and Support Lab., Las Vegas, NV, USA
Metal Oxides in the Environment
Jonsson, H.; Corrales, R.; Haw, J. F.; Park, B.; Song, J.; Aug. 2002; 24 pp.; In English
Report No.(s): DE2005-15010318; No Copyright; Avail: Department of Energy Information Bridge

Oxides are ubiquitous in much of environmental chemistry. Silica and related glasses are potential vehicles by which radioactive elements may be sequestered and stored. The migration of toxic waste in ground water is largely influenced by interactions at the liquid-solid interface, with several metal oxides making up the bulk of soil. In addition, metal oxides with Bronsted acid or Lewis base functionality are potential replacements for many traditional liquid catalysis that are hazardous to work with and difficult to dispose. In this proposal, we targeted two such areas of oxide chemistry. The long-term behavior of silicate materials slated for use in the entombment of high-level waste (HLW), and the use of solid acid metal oxides as replacements for toxic sulfuric and hydrofluoric acid used in industry (referred to as Green Chemistry). Thus, this project encompassed technology that can be used to both remediate and prevent pollution. These oxide systems were studied using density functional theory (DFT). The comparatively large size and complexity of the systems that will be studied made use of high-accuracy electronic structure studies intractable on conventional computers. The 512 node parallel processor housed in the Molecular Science Computing Facility (MSCF) provided the required capability.
NTIS
Catalysis; Ground Water; Hydrofluoric Acid; Metal Oxides; Water Pollution

20050189229 Lawrence Livermore National Lab., Livermore, CA USA
Metal-Insulator Transition in Li and LiH Final Report
Bastea, M.; Cauble, R. C.; Jan. 15, 2002; 10 pp.; In English
Report No.(s): DE2005-15008095; UCRL-ID-146792; No Copyright; Avail: Department of Energy Information Bridge
The main goals of this project were the search for a predicted nonmetallic high-pressure phase of Li and finding the metallization conditions for LiH. It has been predicted by Neaton & Ashcroft at Cornell that the lithium atoms would pair at pressures around 100 GPa and their valence electrons would become localized in the interstitial regions and therefore non-conducting. LiH, an ionic compound, provides the unique opportunity to understand the effects of coupling two elements with opposite tendencies at extreme conditions and to study fundamental principles such as metallization and pairing. We measured the electrical conductivity of liquid lithium at pressures up to 1.8 Mbar and 4-fold compression, achieved through shock reverberation experiments. We found that the results were consistent with a departure of the electronic properties of lithium from the nearly free electron approximation at high pressures and with ionic pairing correlations in the Mbar regime. Given the expected small effect of the temperature on the conductivity at high densities, the apparent conductivity drop and the behavior of the ionic core at the highest pressures could be interpreted as a decrease of the overall volume available for the electrons. It may be interesting to see if the exclusionary effects mentioned above, that lead to a very non-uniform distribution of the valence electrons, translate into the analog of classical depletion forces, enhancing the ionic pairing correlations in a mixture, e.g. LiH. Higher temperatures would ultimately destroy pairing correlations in the liquid. Estimates of the temperatures required should be possible, but need to rely on more detailed calculations, that could be tested against the experimental results of this study.
NTIS
Insulators; Lithium; Electrical Properties; Temperature Effects

20050189238 Lawrence Livermore National Lab., Livermore, CA USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA
Materials Science and Engineering
Lesuer, D. R.; Jan. 1998; 28 pp.; In English
Report No.(s): DE2004-15009526; UCRL-ID-129205; No Copyright; Avail: Department of Energy Information Bridge
During FY-97, work within the Materials Science and Engineering thrust area was focused on material modeling. Their motivation for this work is to develop the capability to study the structural response of materials as well as materials processing. These capabilities have been applied to a broad range of problems, which support many programs at Lawrence Livermore National Laboratory. Recent examples of structural response problems studied include material fracture (such as interface failure), damage in laser optics, the response of weapons components (such as high explosives) and the failure of composite materials. For materials processing, typical problems studied include metal forming, laser processing, casting, and heat treating. To improve our ability to model material behavior, much of the work involves developing new material models and failure models, as well as applying the codes to new problems. Most investigations involve experimental studies to gather basic information on material response and to validate codes or material models. Projects are inherently multi-disciplinary, involving several investigators with expertise in materials and mechanics. The thrust area studies for FY-97 are described in the following three articles: (1) Evolution of Anisotropic Yield Behavior; (2) Modeling of She Localization in Materials; and (3) Modeling of Casting Microstructures and Defects.
NTIS
Mechanical Properties; Metal Working; Plastic Deformation

20050189242 Savannah River Ecology Lab., Aiken, SC, USA, Georgia Univ., Athens, GA, USA, Arizona Univ., Tucson, AZ, USA

Linking Chemical Speciation, Desorption Kinetics, and Bioavailability of U and Ni in Aged-Contaminated Sediments: A Scientific Basis for Natural Attenuation and Risk Assessment

Bertsch, P. M.; Sowder, A.; Jackson, B.; January 2005; 10 pp.; In English

Report No.(s): DE2005-836464; No Copyright; Avail: Department of Energy Information Bridge

The extent to which heavy metals and radionuclides pose an environmental hazard depends on their potential for release to and transport in the environment, i.e., environmental availability, and their potential for introduction into biological systems, i.e., bioavailability. Although there exists a substantial body of literature pertaining to the fate, distribution, and bioavailability of contaminant metals in model laboratory systems, few studies have examined the biogeochemical cycling of heavy metals in complex aged-contaminated soils and sediments at a fundamental level. Even fewer have coupled detailed information on chemical speciation from state-of-the-art microscopic analytical and spectroscopic techniques with macroscopic observations obtained using indirect chemical extractions, metal desorption and leaching experiments, and biological uptake and toxicity assays.

NTIS

Assessments; Contamination; Desorption; Nickel; Reaction Kinetics; Risk; Sediments; Uranium

20050189249 Media and Process Technology, Inc., Pittsburgh, PA USA

Hydrogen Production via a Commercially Ready Inorganic Membrane Reactor. Semi-annual Report, April 1, 2004-September 30, 2004

Liu, P. K.; Mar. 08, 2005; 24 pp.; In English

Report No.(s): DE2005-838014; No Copyright; Avail: Department of Energy Information Bridge

During the 2nd half of Year I, we continued the development of the microporous ceramic layer as a transition layer for the deposition of the carbon molecular sieve membrane on the stainless steel substrate offered by Pall Corp. Based upon the positive result from the feasibility study conducted in the 1st half of Year I, our activities in this period focused on eliminating the high pore size peak and the minimization of defect. A microporous ceramic layer with 40A pore size and \h1% initial flow have been successfully prepared. Further, this modified membrane has demonstrated excellent thermal stability, \h1% initial flow after the 5 thermal cycles. In addition we began the CMS layer deposition on the AccuSep with the ceramic transition layer. The CMS membranes fired at the low temperature range demonstrate an excellent hydrogen permeance, up to \g5 m(sup 3)/m(sup 2)/hr/bar, with the selectivity of (approx)20 for H(sub 2)/N(sub 2). The extremely high permeance is indicative of the extremely thin CMS membrane layer, which becomes possible as a result of the uniform and defect free transition layer. This could be an ideal membrane for hydrogen recovery applications where the hydrogen permeance is the primary concern. Presently we are actively pursuing the intermediate temperature firing to enhance the selectivity to above this range without sacrificing too much permeance.

NTIS

Ceramics; Hydrogen Production; Membranes; Stainless Steels

20050192038 Lawrence Livermore National Lab., Livermore, CA USA

Recent Progress on the Conversion of Surplus Picric Acid/Explosive D to Higher Value Products

Mitchell, A. R.; Hsu, P. C.; Coburn, M. D.; Schmidt, R. D.; Pagoria, P. F.; Jul. 14, 2004; 18 pp.; In English

Report No.(s): DE2005-15014427; UCRL-CONF-205236; No Copyright; Avail: Department of Energy Information Bridge

The global demilitarization of nuclear and conventional munitions is producing millions of pounds of surplus energetic materials. Historically, energetic materials (high explosives, propellants, and pyrotechnics) have been disposed of by open burning/open detonation (OB/OD). The use of OB/OD is becoming unacceptable due to public concerns and increasingly stringent environmental regulations. Clearly, there is a great need to develop environmentally sound and cost-effective alternatives to OB/OD. The conversion of surplus picric acid and/or ammonium picrate (Explosive D) to1,3,5-triamino-2,4,6-trinitrobenzene (TATB) has been subject of extensive process development studies at Lawrence Livermore National Laboratory (LLNL). LLNL, under the direction and sponsorship of the U.S. Army Defense Ammunition Center (DAC), is developing a process for the conversion of picric acid to TATB on a larger scale. In FY 03, a 10 g per batch process was developed with good results. Development for an one pound per batch system is required as part of overall scale up process for producing TATB from the surplus feedstocks.

NTIS

Acids; Ammonium Picrates; Explosives; Picrates

20050192280 NASA Glenn Research Center, Cleveland, OH, USA

Chemical Fabrication Used to Produce Thin-Film Materials for High Power-to- Weight-Ratio Space Photovoltaic Arrays

Hepp, Aloysius F.; Rybicki, George C.; Raffaelle, Ryne P.; Harris, Jerry D.; Hehemann, David G.; Junek, William; Gorse, Joseph; Thompson, Tracy L.; Hollingsworth, Jennifer A.; Buhro, William E.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The key to achieving high specific power (watts per kilogram) space solar arrays is the development of a high-efficiency, thin-film solar cell that can be fabricated directly on a flexible, lightweight, space-qualified durable substrate such as Kapton (DuPont) or other polyimide or suitable polymer film. Cell efficiencies approaching 20 percent at AM0 (air mass zero) are required. Current thin-film cell fabrication approaches are limited by either (1) the ultimate efficiency that can be achieved with the device material and structure or (2) the requirement for high-temperature deposition processes that are incompatible with all presently known flexible polyimide or other polymer substrate materials. Cell fabrication processes must be developed that will produce high-efficiency cells at temperatures below 400 degrees Celsius, and preferably below 300 degress Celsius to minimize the problems associated with the difference between the coefficients of thermal expansion of the substrate and thin-film solar cell and/or the decomposition of the substrate.

Derived from text

Thin Films; Photovoltaic Cells; Solar Cells

20050192345 NASA Glenn Research Center, Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA

Large-Area Atomic Oxygen Facility Used to Clean Fire-Damaged Artwork

Rutledge, Sharon K.; Banks, Bruce A.; Steuber, Thomas J.; Sechkar, Edward A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In addition to completely destroying artwork, fires in museums and public buildings can soil a displayed artwork with so much accumulated soot that it can no longer be used for study or be enjoyed by the public. In situations where the surface has not undergone extensive charring or melting, restoration can be attempted. However, soot deposits can be very difficult to remove from some types of painted surfaces, particularly when the paint is fragile or flaking or when the top surface of the paint binder has been damaged. Restoration typically involves the use of organic solvents to clean the surface, but these solvents may cause the paint layers to swell or leach out. Also, immersion of the surface or swabbing during solvent cleaning may move or remove pigment through mechanical contact, especially if the fire damage extends into the paint binder. A noncontact technique of removing organic deposits from surfaces was developed out of NASA research on the effects of oxygen atoms on various materials. Atomic oxygen is present in the atmosphere surrounding the Earth at the altitudes where satellites typically orbit. It can react chemically with surface coatings or deposits that contain carbon. In the reaction, the carbon is converted to carbon monoxide and some carbon dioxide. Water vapor is also a byproduct of the reaction if the surface contains carbon-hydrogen bonds. To study this reaction, NASA developed Earth-based facilities to produce atomic oxygen for material exposure and testing. A vacuum facility designed and built by the Electro-Physics Branch of the NASA Glenn Research Center at Lewis Field to provide atomic oxygen over a large area for studying reactions in low Earth orbit has been used to successfully clean several full-size paintings. (This facility can accommodate paintings up to 1.5 by 2.1 m. The atomic oxygen plasma is produced between two large parallel aluminum plates using a radiofrequency power source operating at roughly 400 W. Atomic oxygen is generated uniformly over this area at an operating pressure of 1 to 5 mtorr.

Author

Fire Damage; Restoration; Oxygen Atoms; Oxygen Plasma; Carbon Dioxide; Cleaning; Solvents

20050192349 NASA Glenn Research Center, Cleveland, OH, USA

Effects of Carbon Structure and Surface Oxygen on the Carbon's Performance as the Anode in Lithium-Ion Battery Determined

Hung, Ching-Cheh; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Four carbon materials (C1, C2, C3, and C4) were tested electrochemically at the NASA Glenn Research Center at Lewis Field to determine their performance in lithium-ion batteries. They were formed as shown in the figure. This process caused very little carbon loss. Products C1 and C3 contained very little oxygen because of the final overnight heating at 540 C. Products C2 and C4, on the other hand, contained small amounts of basic oxide. The electrochemical test involved cycles of lithium intercalation and deintercalation using C/saturated LiI-50/50 (vol %) ethylene carbonate (EC) and dimethyl carbonate (DMC)/Li half cell. The cycling test, which is summarized in the table, resulted in three major conclusions. The capacity of the carbon with a basic oxide surface converges to a constant 1. value quickly (within 4 cycles), possibly because the oxide

prevents solvent from entering the carbon structure and, therefore, prolongs the carbon s cycle life. Under certain conditions, the disordered carbon can store more lithium than its 2. precursor. These samples and their precursor can intercalate at 200 mA/g and deintercalate at 3. a rate of 2000 mA/g without significant capacity loss.
Author
Carbon Cycle; Intercalation; Order-Disorder Transformations; Carbonates; Electric Batteries; Lithium; Methyl Compounds

20050192426 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Aerosols, Chemistry, and Radiative Forcing: A 3-D Model Analysis of Satellite and ACE-Asia data (ACMAP)
Chin, Mian; Ginoux, Paul; Torres, Omar; Zhao, Xue-Peng; [2005]; 3 pp.; In English
Contract(s)/Grant(s): NAG5-11479
Report No.(s): G-35-B02; No Copyright; Avail: CASI; A01, Hardcopy

We propose a research project to incorporate a global 3-D model and satellite data into the multi-national Aerosol Characterization Experiment-Asia (ACE-Asia) mission. Our objectives are (1) to understand the physical, chemical, and optical properties of aerosols and the processes that control those properties over the Asian-Pacific region, (2) to investigate the interaction between aerosols and tropospheric chemistry, and (3) to determine the aerosol radiative forcing over the Asia-Pacific region. We will use the Georgia TecWGoddard Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) model to link satellite observations and the ACE-Asia measurements. First, we will use the GOCART model to simulate aerosols and related species, and evaluate the model with satellite and in-situ observations. Second, the model generated aerosol vertical profiles and compositions will be used to validate the satellite products; and the satellite data will be used for during- and post- mission analysis. Third, we will use the model to analyze and interpret both satellite and ACE-Asia field campaign data and investigate the aerosol-chemistry interactions. Finally, we will calculate aerosol radiative forcing over the Asian-Pacific region, and assess the influence of Asian pollution in the global atmosphere. We propose a research project to incorporate a global 3-D model and satellite data into
Author
Aerosols; Atmospheric Chemistry; Radiation Transport; Three Dimensional Models; Optical Properties; Ozone

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

20050186914 NASA Lewis Research Center, Cleveland, OH, USA
Novel Ultraviolet-Light-Curable Polyimides
Meador, Michael A.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Polyimides have found broad application in fiber-reinforced composites for aerospace components and as thin films for electronics packaging. Typical routes to processing these materials require temperatures above 200 C. As a result, tooling costs for fabricating components from these composites can be quite high. Recent efforts within the Polymers Branch at the NASA Lewis Research Center have been aimed at developing radiationcurable (with light or electron beams) polyimides. Such materials may enable the processing of polymers and composites at or near room temperature, leading to reduced tooling requirements and costs. A new Diels-Alder route to polyimides has been developed that employs ultraviolet light (UV), rather than heat, to effect polymerization. This approach, which can be carried out at room temperature, is based on a well-known photochemical reaction--the photoenolization of o-methylphenyl ketones. Irradiation of o-methylphenyl ketones, such as 1 in the preceding figure, with UV wavelengths above 300 nm produces a photoenol, 2. This photoenol is unstable, but it persists long enough to undergo Diels-Alder reactions with good dienophiles, such as maleimide, 3. By utilizing a diketone, such as 2,5-dibenzoylp-xylene, 5, and a bismalemide, 6, this chemistry has been used to make a number of polyimides, 7.
Author
Ultraviolet Radiation; Xylene; Polyimides; Photochemical Reactions; Polymerization; Curing; Fiber Composites

20050187004 NASA Lewis Research Center, Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA
Sensor Lead Wires Positioned on SiC-based Monolithic Ceramic and Fiber- reinforced Ceramic Matrix Composite Subcomponents with Flat and Curved Surfaces
Kiser, James D.; Singh, Mritunjay; Lei, Jih-Fen; Martin, Lisa C.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

There is strong interest in the development of silicon carbide-based monolithic ceramic and composite materials and components for demanding, high-temperature applications. Thorough characterization of material properties, including high-temperature testing under simulated or actual operating conditions, is a high priority for programs involved in developing these silicon carbide- (SiC) based materials and components. Members of the Sensors and Electronics Technology Branch at the NASA Lewis Research Center are developing minimally intrusive methods of measuring the properties (such as the surface temperature, strain, and heat flux characteristics) of components and subelements that are being tested or operated in hostile, high-temperature environments. Their primary goal is to instrument the test article or operating component with durable sensors that have a minimal effect on test conditions such as the gas flow across the surface of the item and the material response (including the through-thickness conduction of heat). Therefore, the main thrust of their work has been the development of thin-film sensors (e.g., thermocouples or strain gauges) for use on various advanced material test articles, including SiC/SiC composite components. There was a need for a better method of securing sensor lead wires on SiC-based components and subelements that would be tested at temperatures to 1000 C (or higher), to enhance the durability of the overall minimally intrusive sensor system. To address this need, Lewis researchers devised an alternative approach for positioning the sensor lead wires (which are connected to the thin-film sensors) on SiC or SiC/SiC components. A reaction-forming method of joining was used to strongly bond hoop-shaped monolithic SiC and SiC/SiC composite attachments of various sizes to both flat and curved surfaces of SiC/SiC composite subelements (see the photos). This approach is based on an affordable, robust ceramic joining technology, named ARCJoinT, which was developed at Lewis for the joining of SiC-based ceramics and fiber-reinforced composites.

Author

Wire; Silicon Carbides; Ceramic Matrix Composites; Composite Materials; Conductive Heat Transfer; Fiber Composites; Flat Surfaces

20050187005 NASA Lewis Research Center, Cleveland, OH, USA

Modal Acoustic Emission Used at Elevated Temperatures to Detect Damage and Failure Location in Ceramic Matrix Composites

Morscher, Gregory N.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Ceramic matrix composites are being developed for elevated-temperature engine applications. A leading material system in this class of materials is silicon carbide (SiC) fiber-reinforced SiC matrix composites. Unfortunately, the nonoxide fibers, matrix, and interphase (boron nitride in this system) can react with oxygen or water vapor in the atmosphere, leading to strength degradation of the composite at elevated temperatures. For this study, constant-load stress-rupture tests were performed in air at temperatures ranging from 815 to 960 C until failure. From these data, predictions can be made for the useful life of such composites under similar stressed-oxidation conditions. During these experiments, the sounds of failure events (matrix cracking and fiber breaking) were monitored with a modal acoustic emission (AE) analyzer through transducers that were attached at the ends of the tensile bars. Such failure events, which are caused by applied stress and oxidation reactions, cause these composites to fail prematurely. Because of the nature of acoustic waveform propagation in thin tensile bars, the location of individual source events and the eventual failure event could be detected accurately.

Author

Ceramic Matrix Composites; Degradation; Damage; Silicon Carbides; Fiber Composites; High Temperature; Failure

20050187016 NASA Lewis Research Center, Cleveland, OH, USA

Low-Cost, High Glass-Transition Temperature, Thermosetting Polyimide Developed

Chuang, Kathy C.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

PMR-15 polyimide, developed in the mid-1970's at the NASA Lewis Research Center, is recognized as a state-of-the-art high-temperature resin for composite applications in the temperature range of 500 to 550 F (260 to 288 C). PMR-15 offers easy processing and good property retention at a reasonable cost. For these reasons, it is widely used in both military and commercial aircraft engine components. Traditionally, polyimide composites have been designed for long-term use at 500 to 600 F over thousands of hours. However, new applications in reusable launch vehicles (RLV's) require lightweight materials that can perform for short times (tens of hours) at temperatures between 800 and 1000 F (425 and 538 C). Current efforts at Lewis are focused on raising the use temperature of polyimide composites by increasing the glass-transition temperature of the matrix resins. Achieving this dramatic increase in the upper use temperature without sacrificing polymer and composite processability is a major technical challenge.

Author

Glass Transition Temperature; Low Cost; Polyimides; Resin Matrix Composites

20050187024 NASA Lewis Research Center, Cleveland, OH, USA

Highly Conducting Graphite Epoxy Composite Demonstrated

Gaier, James R.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Weight savings as high as 80 percent could be achieved if graphite polymer composites could replace aluminum in structures such as electromagnetic interference shielding covers and grounding planes. This could result in significant cost savings, especially for the mobile electronics found in spacecraft, aircraft, automobiles, and hand-held consumer electronics. However, such composites had not yet been fabricated with conductivity sufficient to enable these applications. To address this lack, a partnership of the NASA Lewis Research Center, Manchester College, and Applied Sciences, Inc., fabricated nonmetallic composites with unprecedented electrical conductivity. For these composites, heat-treated, vapor-grown graphite fibers were selected which have a resistivity of about 80 mW-cm, more than 20 times more conductive than typical carbon fibers. These fibers were then intercalated with iodine bromide (IBr). Intercalation is the insertion of guest atoms or molecules between the carbon planes of the graphite fibers. Since the carbon planes are not highly distorted in the process, intercalation has little effect on mechanical and thermal properties. Intercalation does, however, lower the carbon fiber resistivity to less than 10 mW-cm, which is comparable to that of metal fibers. Scaleup of the reaction was required since the initial intercalation experiments would be carried out on 20-mg quantities of fibers, and tens of grams of intercalated fibers would be needed to fabricate even small demonstration composites. The reaction was first optimized through a time and temperature study that yielded fibers with a resistivity of 8.7 2 mW-cm when exposed to IBr vapor at 114 C for 24 hours. Stability studies indicated that the intercalated fibers rapidly lost their conductivity when exposed to temperatures as low as 40 C in air. They were not, however, susceptible to degradation by water vapor in the manner of most graphite intercalation compounds. The 1000-fold scaleup experiments concluded that 114 C was near the optimum temperature, but that the intercalation time needed to be lengthened by a factor of 3.

Author

Graphite-Epoxy Composites; Mechanical Properties; Cost Reduction; Electrical Resistivity; Carbon Fibers

20050187111 Brookhaven National Lab., Upton, NY, USA

Recycled Waste-Based Cement Composite Patch Materials for Rapid/Permanent Road Restoration

Sugama, T.; Jul. 2001; 80 pp.; In English

Report No.(s): DE2005-15011144; BNL-73551-2005; No Copyright; Avail: Department of Energy Information Bridge

Over the past year, KeySpan Energy sponsored a research program at Brookhaven National Laboratory (BNL) aimed at recycling boiler ash (BA) and waste water treatment sludge (WWTS) byproducts generated from Keyspan's power stations into potentially useful materials, and at reducing concurrent costs for their disposal. Also, KeySpan has an interest in developing strategies to explicitly integrate industrial ecology and green chemistry. From our collaborative efforts with Keyspan (Diane Blankenhom Project Manager, and Kenneth Yager), we succeeded in recycling them into two viable products; Pb-exchange adsorbents (PEAs), and high-performance cements (HpCs). These products were made from chemically bonded cement and ceramic (CBC) materials that were synthesized through two-step chemical reaction pathways, acid-base and hydration. Using this synthesis technology, both the WWTS and BA served in acting as solid base reactants, and sodium polyphosphate, (-(-NaPO(sub 3)-)-(sub n)), known as an intermediator of fertilizer, was employed as the acid solution reactant. In addition, two commercial cement additives, Secar No. 51 calcium aluminate cement (CAC) and Type I calcium silicate cement (CSC), were used to improve mechanical behavior and to promote the rate of acid-base reaction of the CBC materials.

NTIS

Cements; Composite Materials; Recycling; Restoration; Roads; Waste Utilization

20050188542 NASA Lewis Research Center, Cleveland, OH, USA

Design Tool Developed for Probabilistic Modeling of Ceramic Matrix Composite Strength

Murthy, Pappu L. N.; Mital, Subodh K.; Shah, Ashwin R.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Ceramic matrix composites are being evaluated as candidate materials for many high temperature applications such as engine combustor liners for the High-Speed Civil Transport (HSCT). They are required to have an assured life of several thousand hours. Estimating the reliability of these components is quite a complex process and requires knowledge of the uncertainties that occur at various scales. The properties of ceramic matrix composites (CMC) are known to display a considerable amount of scatter due to variations in fiber/matrix properties, interphase/coating properties, bonding, amount of matrix voids, and many geometry- and fabrication-related parameters such as ply thickness and ply orientations. The objective of this research effort is to account for these uncertainties in a formal way by probabilistically analyzing both the stiffness- and strength related properties of CMC's. In current deterministic approaches, uncertainties are usually accounted for by safety

factors. This approach often yields overly conservative designs, thereby reducing the potential of many advanced composite materials.
Derived from text
Ceramic Matrix Composites; Composite Materials; Fiber-Matrix Interfaces; Matrix Materials

20050189205 Brookhaven National Lab., Upton, NY USA, National Renewable Energy Lab., Golden, CO USA
Self-Assembly Ce Oxide/Organopolysiloxane Composite Coatings
Sugama, T.; Sabatini, R.; Gawlik, K.; January 2005; 48 pp.; In English
Report No.(s): DE2005-15011205; BNL-73602-2005; No Copyright; Avail: Department of Energy Information Bridge

A self-assembly composite synthesis technology was used to put together a Ce(OH)(sub 3)-dispersed poly-acetamide-acetoxyl methyl-propylsiloxane (PAAMPA) organometallic polymer. Three spontaneous reactions were involved; condensation, amidation, and acetoxylation, between the Ce acetate and aminopropylsilane triol (APST) at 150 degrees C. An increase in temperature to 200 degrees C led to the in-situ phase transformation of Ce(OH)(sub 3) into Ce(sub 2)O(sub 3) in the PAAMPA matrix. A further increase to 250 degrees C caused oxidative degradation of the PAAMPA, thereby generating copious fissures in the composite. We assessed the potential of Ce(OH)(sub 3)/ and Ce(sub 2)O(sub 3)/ PAAMPA composite materials as corrosion-preventing coatings for carbon steel and aluminum. The Ce(sub 2)O(sub 3) composite coating displayed better performance in protecting both metals against NaCl-caused corrosion than did the Ce(OH)(sub 3) composite. Using this coating formed at 200 degrees C, we demonstrated that the following four factors played an essential role in further mitigating the corrosion of the metals: First was a minimum susceptibility of coating's surface to moisture; second was an enhanced densification of the coating layer; third was the retardation of the cathodic oxygen reduction reaction at the metal's corrosion sites due to the deposition of Ce(sub 2)O(sub 3) as a passive film over the metal's surface; and, fourth was its good adherence to metals.
NTIS
Acetates; Coatings; Composite Materials; Oxides; Self Assembly

20050189218 Oak Ridge National Lab., TN USA
Durability-Based Design Criteria for an Automotive Structural Composite: Part 2. Background Data and Models
Corum, J. M.; Battiste, R. L.; Brinkman, C. R.; Ren, W.; Ruggles, M. B.; Mar. 16, 1998; 220 pp.; In English
Report No.(s): DE2005-16716; ORNL-6931; No Copyright; Avail: Department of Energy Information Bridge

This background report is a companion to the document entitled 'Durability-Based Design Criteria for an Automotive Structural Composite: Part 1. Design Rules' (ORNL-6930). The rules and the supporting material characterization and modeling efforts described here are the result of a U.S. Department of Energy Advanced Automotive Materials project entitled 'Durability of Lightweight Composite Structures.' The overall goal of the project is to develop experimentally based, durability-driven design guidelines for automotive structural composites. The project is closely coordinated with the Automotive Composites Consortium (ACC). The initial reference material addressed by the rules and this background report was chosen and supplied by ACC. The material is a structural reaction injection-molded isocyanurate (urethane), reinforced with continuous-strand, swirl-mat, E-glass fibers. This report consists of 16 position papers, each summarizing the observations and results of a key area of investigation carried out to provide the basis for the durability-based design guide. The durability issues addressed include the effects of cyclic and sustained loadings, temperature, automotive fluids, vibrations, and low-energy impacts (e.g., tool drops and roadway kickups) on deformation, strength, and stiffness. The position papers cover these durability issues. Topics include (1) tensile, compressive, shear, and flexural properties; (2) creep and creep rupture; (3) cyclic fatigue; (4) the effects of temperature, environment, and prior loadings; (5) a multiaxial strength criterion; (6) impact damage and damage tolerance design; (7) stress concentrations; (8) a damage-based predictive model for time-dependent deformations; (9) confirmatory subscale component tests; and (10) damage development and growth observations.
NTIS
Automobiles; Composite Materials; Design Analysis; Durability; Industries

20050189247 South Dakota School of Mines and Technology, Rapid City, SD, USA
Investigation of the Interphase Region in Polymer Matrix-Glass Fiber Reinforced Composites Using the Interfacial Force Microscope
Winter, R. N.; January 2005; 14 pp.; In English
Report No.(s): DE2005-825904; No Copyright; Avail: Department of Energy Information Bridge

The proposed research was to provide a critical vehicle to enhance South Dakota researchers' abilities to participate in nationally important energy related research while building and strengthening partnerships between the South Dakota School of Mines and Technology (SDSM&T) and Sandia National Laboratories (SNL), Albuquerque, NM. In collaboration with Dr. J.E. Houston of SNL, the inventor of the Interfacial Force Microscope, expertise was to be developed to utilize the IFM in the investigation of nanomechanics in polymer based systems. The IFM was to be used to obtain quantitative and spatially resolved measurements of nanomechanical properties in polymer matrix glass fiber reinforced composites and other polymeric systems. Because of the unique sensor the IFM utilizes, this work held the promise to reveal the critical relationships between the interphase chemistry, mechanical properties, and the adhesion at the reinforcement interface. It was anticipated that the Department of Energy would benefit from this research from the ability to engineer advanced light-weight polymer matrix composites and in the application to aging of polymeric composite systems.
NTIS
Fiber Composites; Glass Fibers; Polymer Matrix Composites

20050192079 NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA
Influence of Compression and Shear on the Strength of Composite Laminates with Z-Pinned Reinforcement
O'Brien, T. Kevin; Krueger, Ronald; June 2005; 71 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): 23R-762-25
Report No.(s): NASA/TM-2005-213768; ARL-TR-3524; L-19141; No Copyright; Avail: CASI; A04, Hardcopy

The influence of compression and shear loads on the strength of composite laminates with z-pins is evaluated parametrically using a 2D Finite Element Code (FLASH). Meshes were generated for three unique combinations of z-pin diameter and density. A laminated plate theory analysis was performed on several layups to determine the bi-axial stresses in the zero degree plies. These stresses, in turn, were used to determine the magnitude of the relative load steps prescribed in the FLASH analyses. Results indicated that increasing pin density was more detrimental to in-plane compression strength than increasing pin diameter. FLASH results for lamina with z-pins were consistent with the closed form results, and FLASH results without z-pins, if the initial fiber waviness due to z-pin insertion was added to the fiber waviness in the material to yield a total misalignment. Addition of 10% shear to the compression loading significantly reduced the lamina strength compared to pure compression loading. Addition of 50% shear to the compression indicated shear yielding rather than kink band formation as the likely failure mode. Two different stiffener reinforced skin configurations with z-pins, one quasi-isotropic and one orthotropic, were also analyzed. Six unique loading cases ranging from pure compression to compression plus 50% shear were analyzed assuming material fiber waviness misalignment angles of 0, 1, and 2 degrees. Compression strength decreased with increased shear loading for both configurations, with the quasi-isotropic configuration yielding lower strengths than the orthotropic configuration.
Author
Compression Loads; Compressive Strength; Shear Strength; Laminates; Plate Theory

20050192159 NASA Glenn Research Center, Cleveland, OH, USA
High-Performance SiC/SiC Ceramic Composite Systems Developed for 1315 C (2400 F) Engine Components
DiCarlo, James A.; Yun, Hee Mann; Morscher, Gregory N.; Bhatt, Ramakrishna T.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As structural materials for hot-section components in advanced aerospace and land-based gas turbine engines, silicon carbide (SiC) ceramic matrix composites reinforced by high performance SiC fibers offer a variety of performance advantages over current bill-of-materials, such as nickel-based superalloys. These advantages are based on the SiC/SiC composites displaying higher temperature capability for a given structural load, lower density (approximately 30- to 50-percent metal density), and lower thermal expansion. These properties should, in turn, result in many important engine benefits, such as reduced component cooling air requirements, simpler component design, reduced support structure weight, improved fuel efficiency, reduced emissions, higher blade frequencies, reduced blade clearances, and higher thrust. Under the NASA Ultra-Efficient Engine Technology (UEET) Project, much progress has been made at the NASA Glenn Research Center in identifying and optimizing two highperformance SiC/SiC composite systems. The table compares typical properties of oxide/oxide panels and SiC/SiC panels formed by the random stacking of balanced 0 degrees/90 degrees fabric pieces reinforced by the indicated fiber types. The Glenn SiC/SiC systems A and B (shaded area of the table) were reinforced by the Sylramic-iBN SiC fiber, which was produced at Glenn by thermal treatment of the commercial Sylramic SiC fiber (Dow Corning, Midland, MI; ref. 2). The treatment process (1) removes boron from the Sylramic fiber, thereby improving fiber creep, rupture, and oxidation resistance and (2) allows the boron to react with nitrogen to form a thin in situ grown BN coating on the fiber surface, thereby providing an oxidation-resistant buffer layer between contacting fibers in the fabric and the final

composite. The fabric stacks for all SiC/SiC panels were provided to GE Power Systems Composites for chemical vapor infiltration of Glenn designed BN fiber coatings and conventional SiC matrices. Composite panels with system B were heat treated at Glenn, and the pores that remained open were filled by silicon melt infiltration (MI). Panels with system A and the other SiC/SiC systems were not heat treated, and remaining open pores in these systems were filled with SiC slurry and silicon MI.
Derived from text
Ceramic Matrix Composites; Engine Parts; Silicon Carbides; Fabrication; Refractory Materials

20050192189 NASA Glenn Research Center, Cleveland, OH, USA
Subscale Testing of a Ceramic Composite Cooled Panel Led to Its Design and Fabrication for Scramjet Engine Testing
Jaskowiak, Martha H.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In a partnership between the NASA Glenn Research Center and Pratt & Whitney, a ceramic heat exchanger panel intended for use along the hot-flow-path walls of future reusable launch vehicles was designed, fabricated, and tested. These regeneratively cooled ceramic matrix composite (CMC) panels offer lighter weight, higher operating temperatures, and reduced coolant requirements in comparison to their more traditional metallic counterparts. A maintainable approach to the design was adopted which allowed the panel components to be assembled with high-temperature fasteners rather than by permanent bonding methods. With this approach, the CMC hot face sheet, the coolant containment system, and backside structure were all fabricated separately and could be replaced individually as the need occurred during use. This maintainable design leads to both ease of fabrication and reduced cost.
Derived from text
Ceramic Matrix Composites; Panels; Regenerative Cooling

20050192207 NASA Glenn Research Center, Cleveland, OH, USA
Constituent-Based Life Models Being Developed for SiC/SiC Composites
DiCarlo, James A.; Yun, Hee Mann; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

For the successful utilization of ceramic matrix composites (CMC) as hot-section components in advanced aeropropulsion engines, the CMC constituents will need to be tailored and optimized to meet all the critical property demands of each component. Under the High-Speed Research (HSR) and Advanced High-Temperature Engine Materials Technology (HITEMP) Programs, the NASA Glenn Research Center at Lewis Field initiated research to develop mechanistic models for key CMC thermostructural properties. These models would describe the effects of different constituent factors (composition, geometry, and volume fraction) and of potential application conditions (stress, time, temperature, and environment) on these properties. Particular focus was placed on both analytical and numerical modeling of state-of-the-art SiC/SiC composites where the primary load-bearing constituents are stoichiometric SiC fibers in a complex multiphase SiC matrix produced by chemical vapor infiltration and melt infiltration. Recent studies have resulted in computer-based numerical models for the elastic modulus, thermal expansion, and thermal conductivity properties of the SiC/SiC system. Additional studies have generated analytical and empirical models for the time dependence of composite rupture strength at temperatures above 2200 F (1200 C), where CMC's have an important thermostructural advantage over current nickel-based superalloys. These life models utilize thermal activation theory and fiber stress-rupture results measured at Glenn to generate Larson-Miller (L M) plots of fiber rupture strength versus q, a single time- and temperature-dependent parameter. Assuming a worse case in which the SiC matrix is cracked, rupture is then controlled by the time-dependent fracture characteristics of the fiber bundles bridging the matrix cracks. With this as the controlling mechanism, one can then use simple composite theory and the fiber L M plots to predict CMC rupture strength versus the q parameter. The dashed line shows the predicted rupture strength of a SiC/SiC composite that is reinforced by a state-of-the-art stoichiometric SiC fiber. For the q parameter, time is in hours and temperature in degrees kelvin. To generate these predictions, a two-dimensional 0 /90 composite with approximately 16 percent fiber in the applied stress direction and an air test environment were assumed. As such, it is possible to compare the model predictions against limited stress-rupture data for this CMC as shown by the data points. The good agreement confirms the rupture model at least for the selected CMC and test conditions. Thus for this particular SiC/SiC composite, one can estimate a 1000-hr rupture strength of approximately 12 ksi at 2400 F (T = 1588 K and q = 39 700 K). At lower CMC application stresses, the SiC matrix is typically uncracked, so both the fiber and matrix constituents share the composite load. In this case, CMC rupture is controlled by the constituent with the longest rupture time based on the creep rate of the composite. Measured Monkman-Grant plots of rupture time versus creep rate for the two SiC constituents have been used to develop CMC life models for this important application condition. NASA and DOD are currently using this information to establish application

and material goals for more advanced CMC's that can be used at even higher temperatures.
Author
Silicon Carbides; Ceramic Matrix Composites; Mathematical Models; Mechanical Properties

20050192210 NASA Glenn Research Center, Cleveland, OH, USA, Case Western Reserve Univ., Cleveland, OH, USA
Directionally Solidified Ceramics Produced
Farmer, Serene C.; Sayir, Ali; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Produced Multiphase, interpenetrating structures are an alternative route to obtaining structural ceramic materials with adequate strength, toughness, and stability for high-temperature aerospace applications. The eutectic architecture, a continuous-reinforcing phase within a higher volume phase or matrix, can be described as a naturally occurring, in situ composite. The phases of a eutectic are thermodynamically compatible at high homologous temperatures. Strong and stable materials have been produced. Toughness, however, remains a technical obstacle. The potential for producing materials with enhanced toughness along with adequate strength and stability was demonstrated using the laser-heated float zone (LHFZ) growth method at the NASA Glenn Research Center at Lewis Field. LHFZ growth at Glenn provides a means to efficiently produce and record the underlying growth phenomena associated with two-phase structures. To initiate directional solidification, a seed of single-crystal sapphire (\h0001\g direction) was lowered onto the molten liquid until wetting occurred and then withdrawn at a constant rate. Neither the crystal nor the source rod was rotated. The materials produced were tested mechanically in tension, and the resulting microstructure was examined with a scanning electron microscope. Both the inherent properties of the constituent phases and the properties of the interface between them affect the mechanical behavior and the fracture surfaces. The following scanning electron micrographs show the microstructures of two different materials that were tested to failure in tension. In the left micrograph, the flat fracture surface is typical of a material that is strong but has low toughness. In the right micrograph, the crack is effectively deflected at the interface between the two phases, achieving higher toughness at moderately lower strength levels. Conducting mechanical tests to determine the high temperature properties of these materials is the next step in determining their eventual suitability.
Author
Ceramics; Directional Solidification (Crystals); Mechanical Properties

20050192215 DYNACS Engineering Co., Inc., USA
Affordable, Robust Ceramic Joining Technology (ARCJoinT) Given 1999 R and D 100 Award
Singh, Mrityunjay; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Advanced ceramics and fiber-reinforced ceramic matrix composites with high strength and toughness, good thermal conductivity, thermal shock resistance, and oxidation resistance are needed for high-temperature structural applications in advanced high-efficiency and high-performance engines, space propulsion components, and land-based systems. The engineering designs of these systems require the manufacturing of large parts with complex shapes, which are either quite expensive or impossible to fabricate. In many instances, it is more economical to build complex shapes by joining together simple geometrical shapes. Thus, joining has been recognized as an enabling technology for the successful utilization of advanced ceramics and fiber-reinforced composite components in high-temperature applications. However, such joints must retain their structural integrity at high temperatures and must have mechanical strength and environmental stability comparable to those of the bulk materials. In addition, the joining technique should be robust, practical, and reliable. ARCJoinT, which is based on the reaction-forming approach, is unique in terms of producing joints with tailorable microstructures. The formation of joints by this approach is attractive since the thermomechanical properties of the joint interlayer can be tailored to be very close to those of the base materials. In addition, high-temperature fixturing is not needed to hold the parts at the infiltration temperature. The joining process begins with the application of a carbonaceous mixture in the joint area, holding the items to be joined in a fixture, and curing at 110 to 120 C for 10 to 20 min. This step fastens the pieces together. Then, silicon or a silicon alloy in tape, paste, or slurry form is applied around the joint region and heated to 1250 to 1425 C (depending on the type of infiltrant) for 10 to 15 min. The molten silicon or silicon-refractory metal alloy reacts with carbon to form silicon carbide with controllable amounts of silicon and other phases as determined by the alloy composition. Joint thickness can be readily controlled through adjustments of the properties of the carbonaceous paste and the applied fixturing force. The photograph shows various shapes of silicon-carbide-based ceramics and fiberreinforced composites that have been joined using ARCJoinT. Thermomechanical and thermochemical characterization of joints is underway for a wide variety of silicon-carbidebased advanced ceramics and fiber-reinforced composites under the hostile environments that will be encountered in engine applications. ARCJoinT, which was developed by researchers at the NASA Glenn Research Center at

Lewis Field, received R&D Magazine's prestigious R&D 100 Award in 1999.
Author
Technology Utilization; Joining; Research and Development; Ceramic Matrix Composites; Manufacturing

20050192222 NASA Glenn Research Center, Cleveland, OH, USA
Surface Coatings in Egyptian Art Characterized Through Spectroscopy
Street, Kenneth W.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

For objects dating back dozens of centuries, very few records of their construction and composition remain. Yet it is extremely important to have accurate information regarding the surface chemistry of art objects when preservation or restorative techniques are applied. Furthermore, it is essential that the object not be substantially consumed during characterization. To this end, the Cleveland Museum of Art has partnered with the microspectroscopy laboratory at the NASA Glenn Research Center at Lewis Field to characterize the surface coating of their prized Egyptian antiquities. Microsamples from the relief of the Nome Gods Bearing Offerings, coffin lids, the bust of Amenhotep III Wearing the Blue Crown), and other art objects were characterized by Fourier Transform Infrared Spectroscopy (FT-IR) to determine the composition and, if possible, identify deterioration products associated with centuries of aging. The characterization is complex because the artisans selectively applied multiple varnishes in various locations of a given object. The different surface coatings appear to have been chosen on the basis of aesthetics, such as color and gloss, rather than protection. The process of identifying the original surface composition is further complicated by the treatments used by early restorers, such as impregnation of painted materials with beeswax or paraffin, materials also used by the original artisans. FT-IR clearly distinguishes wax from plant resin materials, but it is not possible at this time to determine if the wax is from an original application or a restorative measure. There are many applications of various plant resins in the construction of art objects. In the case of the bust of Amenhotep III, several sections of carved stone were glued together. The nose sustained damage and was restored with putty. The bust was finished by the application of various colored pigments and varnish. Plant resin applications include putty for restoration or disguising artisan flaws, binder for the various pigments of paint, and varnish to hold the paint in place or provide a glossy appearance. It is difficult to identify the exact plant providing various resins; however, in many cases it is possible with the use of FT IR, in combination with optical microscopy and fluorescence to differentiate between different resins applied to an object. Finally, animal materials such as hides were used to formulate glues and other liquids that were used in art objects. Animal materials are distinguishable from waxes and resins, but, at this time, we have not identified any in the Egyptian art works that we are examining. The spectra obtained from coatings on the Nome gods relief, a Nefertiti portrait, and three dummy jars are virtually identical, suggesting that the coatings were of similar material. The quality of the spectra obtained from the bust of Amenhotep are distorted because of contamination or age degradation, but several key peaks in the spectra indicate that this coating is a varnish similar to that on other objects. Aside from the academic value of accurately identifying the methods of construction, this information is crucial when attempts are made to reconstruct the original appearance of an object with poorly preserved decorative layers.
Author
Coating; Infrared Spectroscopy; Surface Layers; Artifacts; Characterization

20050192224 Army Research Lab., Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA
Shelf Life of PMR Polyimide Monomer Solutions and Prepregs Extended
Alston, William B.; Scheiman, Daniel A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

PMR (Polymerization of Monomeric Reactants) technology was developed in the mid-1970's at the NASA Glenn Research Center at Lewis Field for fabricating high-temperature stable polyimide composites. This technology allowed a solution of polyimide monomers or prepreg (a fiber, such as glass or graphite, impregnated with PMR polyimide monomers) to be thermally cured without the release of volatiles that cause the formation of voids unlike the non-PMR technology used for polyimide condensation type resins. The initial PMR resin introduced as PMR 15 is still commercially available and is used worldwide by aerospace industries as the state-of-the-art resin for high-temperature polyimide composite applications. PMR 15 offers easy composite processing, excellent composite mechanical property retention, a long lifetime at use temperatures of 500 to 550 F, and relatively low cost. Later, second-generation PMR resin versions, such as PMR II 50 and VCAP 75, offer improvements in the upper-use temperature (to 700 F) and in the useful life at temperature without major compromises in processing and property retention but with significant increases in resin cost. Newer versions of nontoxic (non-methylene dianiline) PMR resins, such as BAX PMR 15, offer similar advantages as originally found for PMR 15 but also with significant

increases in resin cost. Thus, the current scope of the entire PMR technology available meets a wide range of aeronautical requirements for polymer composite applications.
Derived from text
Storage Stability; Polyimides; Monomers; Prepregs

20050192226 NASA Glenn Research Center, Cleveland, OH, USA
Erosion Coatings for High-Temperature Polymer Composites: A Collaborative Project With Allison Advanced Development Company
Sutter, James K.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The advantages of replacing metals in aircraft turbine engines with high-temperature polymer matrix composites (PMC's) include weight savings accompanied by strength improvements, reduced part count, and lower manufacturing costs. Successfully integrating high-temperature PMC's into turbine engines requires several long-term characteristics. Resistance to surface erosion is one rarely reported property of PMC's in engine applications because PMC's are generally softer than metals and their erosion resistance suffers. Airflow rates in stationary turbine engine components typically exceed 2.3 kg/sec at elevated temperatures and pressures. In engine applications, as shown in the following photos, the survivability of PMC components is clearly a concern, especially when engine and component life-cycle requirements become longer. Although very few publications regarding the performance of erosion coatings on PMC's are available particularly in high-temperature applications the use of erosion-resistant coatings to significantly reduce wear on metallic substrates is well documented. In this study initiated by the NASA Glenn Research Center at Lewis Field, a low-cost (less than $140/kg) graphite-fiber-reinforced T650 35/PMR 15 sheet-molding compound was investigated with various coatings. This sheet-molding compound has been compression molded into many structurally complicated components, such as shrouds for gas turbine inlet housings and gearboxes. Erosion coatings developed for PMC s in this study consisted of a two-layered system: a bondcoat sprayed onto a cleaned PMC surface, followed by an erosion-resistant, hard topcoat sprayed onto the bondcoat as shown in following photomicrograph. Six erosion coating systems were evaluated for their ability to withstand harsh thermal cycles, erosion resistance (ASTM G76 83 'Standard Practice for Conducting Erosion Tests by Solid Particle Impingement Using Gas Jets') using Al2O3, and adhesion to the graphite fiber polyimide composite (ASTM D 4541 95 'Pull Off Strength of Coatings'). Glenn and Allison Advanced Development Company collaborated to optimize erosion coatings for gas turbine fan and compressor applications. All the coating systems survived aggressive thermal cycling without spalling. During erosion tests (see the final photo), the most promising coating systems tested had Cr3C2-NiCr and WC-Co as the hard topcoats. In all cases, these coating systems performed significantly better than that with a TiN hard topcoat. When material depth (thickness) loss is considered, the Cr3C2-NiCr and WC-Co coating systems provided, on average, an erosion resistance 8.5 times greater than that for the uncoated PMR 15/T650 35 composite. Similarly, Cr3C2-NiCr and WC-Co coating systems adhered to the PMC substrate during tensile tests significantly better than systems containing a TiN topcoat. Differences in topcoats of Cr3C2-NiCr and WC-Co were determined by considering issues such as cost and environmental impact. The preferred erosion-resistant coating system for PMR 15/T650 35 has WC-Co as the hard topcoat. This system provides the following benefits in comparison to the coating system with Cr3C2-NiCr topcoat: lower powder material cost (15 to 20 percent), environmentally friendly materials (Cr3C2-NiCr is hazardous), and higher deposition yield (10 to 15 percent), which results in less waste.
Author
Coating; Erosion; Turbine Engines; Aircraft Engines; Polymer Matrix Composites; Refractory Materials

20050192227 NASA Glenn Research Center, Cleveland, OH, USA
Near-Net-Shape Processing of Sintered Fibrous Ceramics Achieved
Angel, Paul W.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A variety of sintered fibrous ceramic (SFC) materials have been developed over the last 50 years as thermal barrier materials for reentry applications. SFC materials typically exhibit very low thermal conductivities combined with low densities and good thermal stability up to 2500 F. These materials have flown successfully on the space shuttle orbiters since the 1960's. More recently, the McDonnell Douglas Corporation successfully used SFC tiles as a heat shield on the underside of its DC X test vehicle. For both of these applications, tiles are machined from blocks of a specific type of SFC called an alumina-enhanced thermal barrier (AETB). The sizes of these blocks have been limited by the manufacturing process. In addition, as much as 80 to 90 percent of the material can be lost during the machining of tiles with significant amounts of curvature. To address these problems, the NASA Glenn Research Center at Lewis Field entered a cooperative contract with the Boeing Company to develop a vacuum-assisted forming process that can produce large (approximately 4 square feet), severely contoured panels of AETB while saving costs in comparison to the conventional cast-and-machine billet process. For shuttle use, AETB is slurry cast, drained, and fired to form square billets conforming to the shape of the filtration box. The

billets are then cut into tiles of the appropriate size for thermally protecting the space shuttle. Processing techniques have limited the maximum size of AETB billets to 21.5 square inches by 6.5-in. thick, but the space shuttles use discrete heat shield tiles no more than 8 to 12 square inches. However, in other applications, large, complex shapes are needed, and the tiling approach is undesirable. For such applications, vacuum-assisted forming can produce large parts with complex shapes while reducing machining waste and eliminating cemented joints between bonded billets. Because it allows contoured shapes to be formed, material utilization is inherently high. Initial estimates show that the amount of material lost during machining can be reduced by 50 percent or more. In addition, a fiber alignment favorable for minimum heat transfer is maintained for all panel shapes since the fibers are aligned parallel to the contoured surface of the forming tool or mold. The vacuum-assisted forming process can complete the entire forming operation in a matter of minutes and can produce multiple parts whose size is limited only by the size of the forming tool. To date, panels as large as 2 square feet have been demonstrated The vacuum-assisted forming process starts with the fabrication of a permeable forming tool, or mold, with the proper part contour. This reusable tool is mounted over an internal rib support structure, as depicted in the diagram, such that a vacuum can be pulled on the bottom portion of the tool. AETB slurry is then poured over and around the tool, liquid is drawn from the slurry, and the part forms over the tool surface. The part is then dried, fired, and finished machined. Future plans include an evaluation of the need for additional coatings and surface-toughness treatments to extend the durability and performance of this material. Author

Ceramics; Fabrication; Fibers; Sintering; Forming Techniques

20050192250 NASA Glenn Research Center, Cleveland, OH, USA, Northrop Grumman Corp., USA, Michigan State Univ., East Lansing, MI, USA

Polymer/Silicate Nanocomposites Used to Manufacture Gas Storage Tanks With Reduced Permeability

Campbell, Sandi G.; Johnston, Chris; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Over the past decade, there has been considerable research in the area of polymer-layered silicate nanocomposites. This research has shown that the dispersion of small amounts of an organically modified layered silicate improves the polymer strength, modulus, thermal stability, and barrier properties. There have been several reports on the dispersion of layered silicates in an epoxy matrix. Potential enhancements to the barrier properties of epoxy/silicate nanocomposites make this material attractive for low permeability tankage. Polymer matrix composites (PMCs) have several advantages for cryogenic storage tanks. They are lightweight, strong, and stiff; therefore, a smaller fraction of a vehicle's potential payload capacity is used for propellant storage. Unfortunately, the resins typically used to make PMC tanks have higher gas permeability than metals. This can lead to hydrogen loss through the body of the tank instead of just at welds and fittings. One approach to eliminate this problem is to build composite tanks with thin metal liners. However, although these tanks provide good permeability performance, they suffer from a substantial mismatch in the coefficient of thermal expansion, which can lead to failure of the bond between the liner and the body of the tank. Both problems could be addressed with polymersilicate nanocomposites, which exhibit reduced hydrogen permeability, making them potential candidates for linerless PMC tanks. Through collaboration with Northrop Grumman and Michigan State University, nanocomposite test tanks were manufactured for the NASA Glenn Research Center, and the helium permeability was measured. An organically modified silicate was prepared at Michigan State University and dispersed in an epoxy matrix (EPON 826/JeffamineD230). The epoxy/silicate nanocomposites contained either 0 or 5 wt% of the organically modified silicate. The tanks were made by filament winding carbon fibers with the nanocomposite resin. Helium permeability was measured by Northrop Grumman, showing that the leak rate/day of the nanocomposite matrix tank was approximately 80-percent less than that of the neat epoxy matrix tank. Author

Nanocomposites; Permeability; Storage Tanks; Silicates; Polymers; Cryogenic Tanks; Gases

20050192256 NASA Glenn Research Center, Cleveland, OH, USA

Erosion Coatings Developed to Increase the Life and Durability of Composites

Sutter, James K.; Naik, Subhash K.; Bowman, Cheryl L.; Siefker, Robert; Miyoshi, Kazuhisa; Perusek, Gail P.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Both the NASA Glenn Research Center and the Allison Advanced Development Company (AADC) have worked to develop and demonstrate erosion-resistant coatings that would increase the life and durability of composite materials used in commercial aircraft engines. These composite materials reduce component weight by 20 to 30 percent and result in less fuel burn and emissions and more fuel savings. Previously, however, their use was limited because of poor erosion resistance, which causes concerns about safety and leads to high maintenance costs. The coatings were tested by the University of Cincinnati, and the composites were manufactured by Texas Composites and coated by Engelhard and NASA Glenn.

Rolls-Royce Corporation uses composite materials, which are stronger and less dense than steel or titanium, to make bypass vanes for their AE3007 engines. These engines are widely used in regional jet aircraft (Embraer) and unmanned air vehicles such as the Northrop Grumman Global Hawk. Coatings developed by NASA/Rolls-Royce can reduce erosion from abrasive materials and from impurities in the air that pass over these vanes, allowing Rolls-Royce to take advantage of the benefits of composite materials over titanium without the added costs of increased maintenance and/or engine failure. The Higher Operating Temperature Propulsion Components (HOTPC) Project developed cost-effective, durable coatings as part of NASA's goal to increase aviation system capacity growth. These erosion coatings will reduce the number of special inspections or instances of discontinued service due to erosion, allowing aircraft capacity to be maintained without inconveniencing the traveling public. A specific example of extending component life showed that these coatings increased the life of graphite fiber and polymer composite bypass vanes up to 8 times over that of the uncoated vanes. This increased durability allows components to operate to full design life without the fear of wear or failure. Recently, Rolls-Royce completed over 2000 hr of engine testing with the coated fan exit bypass vanes. There was no loss of coating after nearly 5000 typical engine cycles. Midway through the engine tests, the coated vanes were removed from the engine during a scheduled maintenance and inspection period. The vanes were shipped back to Glenn, where they underwent further stress testing in the Structural Dynamics Lab, mimicking more extreme conditions than those typical of the AE3007 engine cycle. These vanes were then replaced in the AE3007 and subjected to another 1000 hr of engine tests. Once again, there was no loss of coating and only a minimal appearance of cracking.

Author

Coatings; Composite Materials; Erosion; Life (Durability); Commercial Aircraft

20050192259 NASA Glenn Research Center, Cleveland, OH, USA

Coating Development for GRCop-84 Liners for Reusable Launch Vehicles Aided by Modeling Studies

Raj, Sai V.; Ghosn, Louis J.; Research and Technology 2003; May 2004; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The design of the next generation of reusable launch vehicles calls for using GRCop-84 copper alloy liners based on a composition invented at the NASA Glenn Research Center. Despite its considerable advantage over other copper alloys, it is expected that GRCop-84 will suffer from environmental degradation depending on the type of rocket fuels used and on thermomechanical fatigue. Applying protective coatings on GRCop-84 substrates can minimize or eliminate many of these problems and extend the operational life of the combustion liner. This could increase component reliability, shorten depot maintenance turnaround times, and lower operating costs. Therefore, Glenn is actively pursuing the development of advanced coatings technology for GRCop-84 liners. Technology is being developed in four major areas: (1) new metallic coating compositions, (2) application techniques, (3) test methods, and (4) life prediction design methodology using finite element analysis. The role of finite element analysis in guiding the coating effort is discussed in this report. Thermal analyses were performed at Glenn for different combinations of top- and bondcoat compositions to determine the temperature variation across the coated cross section with the thickness of the top coat. These calculations were conducted for simulated LH2/LO2 booster engine conditions assuming that the bond coat had a constant thickness of 50 m. The preceding graphs show the predicted temperatures at the outer surface of the top coat (hot wall), at the top-coat/bond-coat interface, at the bond-coat/GRCop-84 interface, and at the GRCop-84 cold wall as a function of top-coat thickness for Cu- 26(wt%)Cr top coat (top graph), Ni-17(wt%)Cr-6%Al-0.5%Y top coat and Cu-26%Cr bond coat, and NiAl top coat and Ni bond coat. In all cases, the temperature of the top coat at the hot wall increased with increasing top-coat thickness and with corresponding decreases in the temperatures at the two interfaces and the cold wall. These temperatures are not acutely sensitive to the thermal conductivity of the top coat when it exceeds 25 and 50 W/m/K for low and high heat flux engines. This observation is significant for two reasons. First, several different top-coat compositions can be evaluated as potential protective coatings without loss in the heat-transfer efficiency of the coated system. Second, materials with thermal conductivities less than the critical values of 25 or 50 W/m/K are more likely to act as thermal barrier coatings. The deposition of overlay coatings on GRCop-84 substrates results in the development of residual stresses. The presence of these residual stresses influences the probability of coating spallation, the thermal cycling life, and the fatigue properties of the coated substrate during use. Since it is important to understand how these stresses develop during the vacuum-plasma-spraying coating deposition process, the nature and magnitudes of the cool-down residual stresses were calculated and compared with experimentally determined values across the coated cross section of a disk specimen. The calculations were conducted assuming that the specimen cools down to room temperature from vacuum plasma-spraying temperatures of either 250 or 650 C. The effects of coating the substrate with and without grit blasting were also theoretically examined. The final graph compares the predicted and the experimental results for a GRCop-84 disk coated with about a 50- m-thick Ni bond coat and a 75- to 100- m NiAl top coat, where the curves for NASA-2 assume the presence of a prior residual stress generated by grit blasting under conditions similar

to the experimental situation. The predicted cool-down in-plane stresses were compressive in both the NiAl top coat and the Ni bond coat. They were also compressive in the substrate to a depth of about 0.25 mm from the Ni/GRCop-84 interface when the vacuum-plasma-spraying temperature was low. However, using a higher plasma spraying temperaturs likely to leave the substrate under a small tensile stress to counter the compressive stresses in the bond and top coats because of the relaxation of residual stresses generated in the substrate during the grit blasting of its surface prior to spraying. These results suggest that the NiAl and Ni coatings are unlikely to spall after spraying as confirmed by the microstructural observations shown in the following photomicrograph of an as-sprayed specimen. Finally, it is noted that the calculated and experimental results are not in complete agreement, which indicates that both the experimental and modeling techniques need further refinement.
Author
Linings; Reusable Launch Vehicles; Models; Metal Coatings

20050192260 NASA Glenn Research Center, Cleveland, OH, USA
Ceramic Matrix Composite Vane Subelements Tested in a Gas Turbine Environment
Verrilli, Michael J.; Robinson, R. Craig; Calomino, Anthony M.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The use of ceramic matrix composites (CMCs) as vanes for the next generation of turbine engines is under evaluation for improving engine performance, such as lowering emissions and enabling higher cycle efficiency, relative to today's engines with superalloy hot section components. Because of the high-temperature capability of this class of materials, CMC vanes would be able to operate with higher combustion exit temperatures than today's engines can. Alternatively, a potential vane cooling requirement reduction of 15 to 25 percent for a CMC, such as SiC/SiC, relative to a single-crystal superalloy would be realized if the combustion operation was not altered.
Derived from text
Ceramic Matrix Composites; Vanes; Gas Turbines

20050192334 NASA Glenn Research Center, Cleveland, OH, USA
Prepreg and Melt Infiltration Technology Developed for Affordable, Robust Manufacturing of Ceramic Matrix Composites
Singh, Mrityunjay; Petko, Jeannie F.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Affordable fiber-reinforced ceramic matrix composites with multifunctional properties are critically needed for high-temperature aerospace and space transportation applications. These materials have various applications in advanced high-efficiency and high-performance engines, airframe and propulsion components for next-generation launch vehicles, and components for land-based systems. A number of these applications require materials with specific functional characteristics: for example, thick component, hybrid layups for environmental durability and stress management, and self-healing and smart composite matrices. At present, with limited success and very high cost, traditional composite fabrication technologies have been utilized to manufacture some large, complex-shape components of these materials. However, many challenges still remain in developing affordable, robust, and flexible manufacturing technologies for large, complex-shape components with multifunctional properties. The prepreg and melt infiltration (PREMI) technology provides an affordable and robust manufacturing route for low-cost, large-scale production of multifunctional ceramic composite components.
Derived from text
Prepregs; Ceramic Matrix Composites; Composite Materials

20050192357 Army Research Lab., Cleveland, OH, USA
Method Developed for Improving the Thermomechanical Properties of Silicon Carbide Matrix Composites
Bhatt, Ramakrishna T.; DiCarlo, James A.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Today, a major thrust for achieving engine components with improved thermal capability is the development of fiber-reinforced silicon-carbide (SiC) matrix composites. These materials are not only lighter and capable of higher use temperatures than state-of-the-art metallic alloys and oxide matrix composites (approx. 1100 C), but they can provide significantly better static and dynamic toughness than unreinforced silicon-based monolithic ceramics. However, for successful application in advanced engine systems, the SiC matrix composites should be able to withstand component service stresses and temperatures for the desired component lifetime. Since the high-temperature structural life of ceramic materials is typically controlled by creep-induced flaw growth, a key composite property requirement is the ability to display high creep

resistance under these conditions. Also, because of the possibility of severe thermal gradients in the components, the composites should provide maximum thermal conductivity to minimize the development of thermal stresses. State-of-the-art SiC matrix composites are typically fabricated via a three-step process: (1) fabrication of a component-shaped architectural preform reinforced by high-performance fibers, (2) chemical vapor infiltration of a fiber coating material such as boron nitride (BN) into the preform, and (3) infiltration of a SiC matrix into the remaining porous areas in the preform. Generally, the highest performing composites have matrices fabricated by the CVI process, which produces a SiC matrix typically more thermally stable and denser than matrices formed by other approaches. As such, the CVI SiC matrix is able to provide better environmental protection to the coated fibers, plus provide the composite with better resistance to crack propagation. Also, the denser CVI SiC matrix should provide optimal creep resistance and thermal conductivity to the composite. However, for adequate preform infiltration, the CVI SiC matrix process typically has to be conducted at temperatures below 1100 C, which results in a SiC matrix that is fairly dense, but contains metastable atomic defects and is nonstoichiometric because of a small amount of excess silicon. Because these defects typically exist at the matrix grain boundaries, they can scatter thermal phonons and degrade matrix creep resistance by enhancing grain-boundary sliding. To eliminate these defects and improve the thermomechanical properties of ceramic composites with CVI SiC matrices, researchers at the NASA Glenn Research Center developed a high-temperature treatment process that can be used after the CVI SiC matrix is deposited into the fiber preform. Derived from text

Ceramic Matrix Composites; Chemical Vapor Infiltration; Crack Propagation; Grain Boundaries; Silicon Carbides; Engine Parts

20050192394 NASA Glenn Research Center, Cleveland, OH, USA

Curved Thermopiezoelectric Shell Structures Modeled by Finite Element Analysis

Lee, Ho-Jun; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

'Smart' structures composed of piezoelectric materials may significantly improve the performance of aeropropulsion systems through a variety of vibration, noise, and shape-control applications. The development of analytical models for piezoelectric smart structures is an ongoing, in-house activity at the NASA Glenn Research Center at Lewis Field focused toward the experimental characterization of these materials. Research efforts have been directed toward developing analytical models that account for the coupled mechanical, electrical, and thermal response of piezoelectric composite materials. Current work revolves around implementing thermal effects into a curvilinear-shell finite element code. This enhances capabilities to analyze curved structures and to account for coupling effects arising from thermal effects and the curved geometry. The current analytical model implements a unique mixed multi-field laminate theory to improve computational efficiency without sacrificing accuracy. The mechanics can model both the sensory and active behavior of piezoelectric composite shell structures. Finite element equations are being implemented for an eight-node curvilinear shell element, and numerical studies are being conducted to demonstrate capabilities to model the response of curved piezoelectric composite structures (see the figure).

Author

Piezoelectricity; Shape Control; Shells (Structural Forms); Composite Materials; Composite Structures; Finite Element Method

20050192413 NASA Glenn Research Center, Cleveland, OH, USA

GENOA-PFA: Progressive Fracture in Composites Simulated Computationally

Murthy, Pappu L. N.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

GENOA-PFA is a commercial version of the Composite Durability Structural Analysis (CODSTRAN) computer program that simulates the progression of damage ultimately leading to fracture in polymer-matrix-composite (PMC) material structures under various loading and environmental conditions. GENOA-PFA offers several capabilities not available in other programs developed for this purpose, making it preferable for use in analyzing the durability and damage tolerance of complex PMC structures in which the fiber reinforcements occur in two- and three-dimensional weaves and braids. GENOA-PFA implements a progressive-fracture methodology based on the idea that a structure fails when flaws that may initially be small (even microscopic) grow and/or coalesce to a critical dimension where the structure no longer has an adequate safety margin to avoid catastrophic global fracture. Damage is considered to progress through five stages: (1) initiation, (2) growth, (3) accumulation (coalescence of propagating flaws), (4) stable propagation (up to the critical dimension), and (5) unstable or very rapid propagation (beyond the critical dimension) to catastrophic failure. The computational simulation of progressive failure involves formal procedures for identifying the five different stages of damage and for relating the amount of damage at each stage to the overall behavior of the deteriorating structure. In GENOA-PFA, mathematical modeling of the composite physical

behavior involves an integration of simulations at multiple, hierarchical scales ranging from the macroscopic (lamina, laminate, and structure) to the microscopic (fiber, matrix, and fiber/matrix interface), as shown in the figure. The code includes algorithms to simulate the progression of damage from various source defects, including (1) through-the-thickness cracks and (2) voids with edge, pocket, internal, or mixed-mode delaminations.
Author
Computerized Simulation; Fracturing; Structural Analysis; Polymer Matrix Composites; Mathematical Models; Delaminating; Failure; Cracks; Durability

20050192414 NASA Glenn Research Center, Cleveland, OH, USA
Automated Guided-Wave Scanning Developed to Characterize Materials and Detect Defects
Martin, Richard E.; Gyekenyeski, Andrew L.; Roth, Don J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Nondestructive Evaluation (NDE) Group of the Optical Instrumentation Technology Branch at the NASA Glenn Research Center has developed a scanning system that uses guided waves to characterize materials and detect defects. The technique uses two ultrasonic transducers to interrogate the condition of a material. The sending transducer introduces an ultrasonic pulse at a point on the surface of the specimen, and the receiving transducer detects the signal after it has passed through the material. The aim of the method is to correlate certain parameters in both the time and frequency domains of the detected waveform to characteristics of the material between the two transducers. The scanning system is shown. The waveform parameters of interest include the attenuation due to internal damping, waveform shape parameters, and frequency shifts due to material changes. For the most part, guided waves are used to gauge the damage state and defect growth of materials subjected to various mechanical or environmental loads. The technique has been applied to polymer matrix composites, ceramic matrix composites, and metal matrix composites as well as metallic alloys. Historically, guided wave analysis has been a point-by-point, manual technique with waveforms collected at discrete locations and postprocessed. Data collection and analysis of this type limits the amount of detail that can be obtained. Also, the manual movement of the sensors is prone to user error and is time consuming. The development of an automated guided-wave scanning system has allowed the method to be applied to a wide variety of materials in a consistent, repeatable manner. Experimental studies have been conducted to determine the repeatability of the system as well as compare the results obtained using more traditional NDE methods. The following screen capture shows guided-wave scan results for a ceramic matrix composite plate, including images for each of nine calculated parameters. The system can display up to 18 different wave parameters. Multiple scans of the test specimen demonstrated excellent repeatability in the measurement of all the guided-wave parameters, far exceeding the traditional point-by-point technique. In addition, the scan was able to detect a subsurface defect that was confirmed using flash thermography This technology is being further refined to provide a more robust and efficient software environment. Future hardware upgrades will allow for multiple receiving transducers and the ability to scan more complex surfaces. This work supports composite materials development and testing under the Ultra-Efficient Engine Technology (UEET) Project, but it also will be applied to other material systems under development for a wide range of applications.
Author (revised)
Detection; Defects; Automatic Control; Scanners; Composite Materials; Ultrasonic Wave Transducers

20050192417 Georgia Inst. of Tech., Atlanta, GA, USA
Determination of Interlaminar Toughness of IM7/977-2 Composites at Temperature Extremes and Different Thicknesses
Johnson, W. S.; Pavlick, M. M.; Oliver, M. S.; May 2005; 28 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG-1-02003; GA Tech Proj E-18-A19; No Copyright; Avail: CASI; A03, Hardcopy

Composite materials are being used in the aerospace industry as a means of reducing vehicle weight. In particular, polymer matrix composites (PMC) are good candidates due to their high strength-to-weight and high stiffness-to-weight ratios. Future reusable space launch vehicles and space exploration structures will need advanced light weight composites in order to minimize vehicle weight while demonstrating robustness and durability, guaranteeing high factors of safety. In particular, the implementation of composite cryogenic propellant fuel tanks (cryotanks) for future reusable launch vehicles (RLVs) could greatly reduce the vehicle's weight versus identically sized cryotanks constructed of metallic materials. One candidate composite material for future cryotank designs is IM7/977-2, which is a graphite/epoxy system. A successful candidate must demonstrate reasonable structural properties over a wide range of temperatures. Since the matrix material is normally the weak link in the composite, tests that emphasize matrix-dominated behavior need to be conducted. Therefore, the objective of this work is to determine the mode I interlaminar fracture toughness of 'unidirectional' 8-ply and 16-ply IM7/977-2 through experimental testing. Tests were performed at -196 degrees Celsius (-320 degrees Fahrenheit), 22 degrees Celsius (72 degrees

Fahrenheit), 93 degrees Celsius (200 degrees Fahrenheit) and 160 degrees C (320 degrees Fahrenheit). Low temperature testing was completed while the specimen was submerged in a liquid nitrogen bath. High temperature testing was completed in a temperature-controlled oven.
Author
Composite Materials; Cryogenics; Polymer Matrix Composites; Graphite-Epoxy Composites

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INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use of inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see category *34 Fluid Dynamics and Thermodynamics*. For astrochemistry see category *90 Astrophysics*.

20050187085 Department of Energy, Washington, DC USA
Selective Oxidation of Benzene to Phenol. Final Report
Kung, H.; Marshall, C.; Zhang, C.; Sep. 29, 2000; 14 pp.; In English
Report No.(s): DE2005-824998; DOE/CH/10932-1; No Copyright; Avail: Department of Energy Information Bridge
Direct catalytic oxidation of commodity aromatics to phenolic compounds was studied by a team from Akzo Nobel Chemicals, Argonne National Lab., and Northwestern University. Results did not exceed previously published performance. The object of the project was to selectively oxidize benzene to phenol using a conventional oxidant.
NTIS
Benzene; Oxidation; Phenols

20050187086 Columbia Univ., New York, NY, USA
Experimental and Theoretical Studies of Nucleation in Supercooled Liquid Silicon
Im, J. S.; Apr. 2004; 14 pp.; In English
Report No.(s): DE2005-825152; No Copyright; Avail: Department of Energy Information Bridge
The original objectives of the present program consisted of two specific nucleation-related research activities; (1) to provide a set of experimental data that will enable the quantitative examination of classical nucleation theory, and (2) to describe the phenomenon of nucleation by developing general expressions of nucleation that include both the thermal and athermal components and that correctly consider and incorporate the transient effects that arise from the nonstationary cluster distribution profile.
NTIS
Nucleation; Silicon

20050187113 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Consejo Superior de Investigaciones Cientificas, Madrid, Spain
Competitive Sorption of Cadmium and Lead in Acid Soils of Central Spain
January 2005; 38 pp.; In English
Report No.(s): DE2005-836041; No Copyright; Avail: Department of Energy Information Bridge
The bioavailability and ultimate fate of heavy metals in the environment are controlled by chemical sorption. To assess competitive sorption of Pb and Cd, batch equilibrium experiments (generating sorption isotherms) and kinetics sorption studies were performed using single and binary metal solutions in surface samples of four soils from central Spain. For comparisons between soils, as well as, single and binary metal solutions, soil chemical processes were characterized using the Langmuir equation, ionic strength, and an empirical power function for kinetic sorption. In addition, soil pH and clay mineralogy were used to explain observed sorption processes. Sorption isotherms were well described by the Langmuir equation and the sorption kinetics were well described by an empirical power function within the reaction times in this study.
NTIS
Cadmium; Heavy Metals; Lead (Metal); Soils; Sorption; Spain

20050188510 NASA Lewis Research Center, Cleveland, OH, USA
Innovative, Inexpensive Etching Technique Developed for Polymer Electro- Optical Structures
Nguyen, Hung D.; Research and Technology 1998; April 1999; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy
Electro-optic, polymer-based integrated optic devices for high-speed communication and computing applications offer

potentially significant advantages over conventional inorganic electro-optic crystals. One key area of integrated optical technology--primary processing and fabrication--may particularly benefit from the use of polymer materials. However, as efforts concentrate on the miniaturization of electro-integrated circuit pattern geometries, the ability to etch fine features and smoothly sloped sidewalls is essential to make polymers useful for electro-integrated circuit applications. There are many existing processes available to etch polymer materials, but they all yield nearly vertical sidewalls. Vertical sidewalls are too difficult to reliably cover with a metal layer, and incomplete metalization degrades microwave performance, particularly at high frequency. However, obtaining a very sloped sidewall greatly improves the deposition of metal on the sidewall, leading to low-loss characteristics, which are essential to integrating these devices in highspeed electro-optic modulators. The NASA Lewis Research Center has developed in-house an inexpensive etching technique that uses a photolithography method followed by a simple, wet chemical etching process to etch through polymer layers. In addition to being simpler and inexpensive, this process can be used to fabricate smoothly sloped sidewalls by using a commercial none rodible mask: Spin-On-Glass. A commercial transparent material, Spin-On-Glass, uses processes and equipment similar to that for photoresist techniques.
Derived from text
Electro-Optics; Etching; Polymer Chemistry

20050189152 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Surface Oxidation Study of Uranium Dioxide Under Wet and Dry Conditions
Brett, Gary T.; Mar. 2005; 184 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DE-A107-02ID1382
Report No.(s): AD-A434313; AFIT/GNE/ENP/05-01; No Copyright; Avail: CASI; A09, Hardcopy

The surface oxidation of pressed uranium dioxide (UO2) powder under controlled environmental conditions and the oxidation and reduction of pressed uranium trioxide (UO3) powder are presented. This is a continuing research project in the investigation of the oxidation of UO2 powder using Photoluminescence (PL) Spectroscopy. UO2 particles exposed to the ambient atmosphere will oxidize into a number of chemical complexes (specifically hydrates, hydroxides, and carbonates). During certain of these oxidation processes, the uranium ion can lose two of its electrons and change from uranous (UIV+) to uranyl (UVI+). This research is an attempt to monitor and control the oxidation of UO2 as well as the development of the uranyl ion from the uranous ion and model their behavior under both wet and dry atmospheric conditions. Two UO2 samples were created by pressing UO2 powder into a tungsten screen and were then subjected to a pure, dry oxygen environment and a wet oxygen environment at temperatures below 200 C. The UO2 oxidation was periodically monitored with in-situ PL spectroscopy. Using this analysis method, I was not able to successfully distinguish between the different uranium oxide compounds as they were formed under the different weathering conditions enforced at this temperature.
DTIC
Dioxides; Drying; Oxidation; Uranium; Uranium Compounds

20050189159 Naval Postgraduate School, Monterey, CA USA
A Microstructural and Mechanical Property Correlation of Friction Stir Processed Nickel Aluminum Bronze
Williams, Robert A.; Sep. 2004; 71 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434667; No Copyright; Avail: Defense Technical Information Center (DTIC)

Friction Stir Processing (FSP) is novel technique for localized modification of the surface layer of materials. FSP produces high local strains, strain rates and local temperatures that are 0.8 - 0.9 Tm, where Tm is the melting point. The processing enhances the microstructural and mechanical properties of materials through intense plastic deformation. This thesis examines the microstructure and tensile properties in FSP'ed Nickel Aluminum Propeller Bronze (NAB) as a function of position in the stir zone using a unique miniature tensile sample design. Test materials were single and multi-pass FSP runs from both 6 mm and 13 mm tools. Tensile ductility was observed to increase from 11 percent to more than 30 percent elongation to fracture at locations along the center of the stir zone. Yield and ultimate strengths also increased two-fold. These improved properties were associated with the formation of Widmanst tten Alpha and fine, equiaxed Alpha at peak temperatures of approximately 1000 C in these locations. Some locations in the heat affected zone (HAZ) or thermomechanically affected zone (TMAZ) exhibited ductilities below that of as-cast material. Such regions had microstructures that contained a dark-etching constituent formed by cooling after being heated to approximately 800 C.
DTIC
Aluminum; Bronzes; Friction; Friction Stir Welding; Mechanical Properties; Microstructure; Nickel

20050189214 Louisville Univ., KY, USA
Organometallic Chemistry of Carbon Dioxide
Sep. 26, 2002; 26 pp.; In English
Report No.(s): DE2005-825899; No Copyright; Avail: Department of Energy Information Bridge

Research focused on C(sub 1) transition metal complexes that are relevant to CO(sub 2) activation and fixation. First, we prepared and studied new metallocarboxylic acids, a class of compounds proposed as intermediates in the Water Gas Shift reaction and CO(sub 2) reductions, and the corresponding metallocarboxylate anions. Next, we prepared and structurally characterized a large number of CO(sub 2)-bridged bimetallic compounds (models for metal surface-bound CO(sub 2)) and established structure-spectra correlations for the three general types of compounds identified. The next phase involved the synthesis and studies of putative catalytic intermediates derived from rhenium and ruthenium polypyridyl complexes in order to establish their fundamental reaction characteristics. Finally, we progressed to the design of a possible catalytic sequence which could account for C(sub 2) products formed in ruthenium-catalyzed CO(sub 2) reductions and to the synthesis, characterization and studies of the reactions of expected intermediates in the catalytic sequence.
NTIS
Carbon Dioxide; Organometallic Compounds; Transition Metals

20050189224 Lund Univ., Sweden
Reduction of Ammonia and Tar in Pressurized Biomass Gasification
Wang, W.; Olofsson, G.; January 2005; 16 pp.; In English
Report No.(s): DE2005-836333; No Copyright; Avail: Department of Energy Information Bridge

This work focuses on the development of catalytic candle filters for the simultaneous removal of tars and particles from the biomass gasification gas at high temperature. An improvement of sulphur resistance of the nickel-activated catalytic filter was developed by the addition of CaO. The influences of preparation procedure of catalytic filter, the ratio of Ni/CaO and the loading of Ni and CaO on the performance of the catalytic filter were investigated.
NTIS
Ammonia; Biomass; Gasification; Renewable Energy; Tars

20050189228 Ames Lab., IA, USA, Oak Ridge National Lab., TN USA
Crystal Structure of Thorium and Zirconium Dihyrdrides by X-Ray and Neutron Diffractions
Rundle, R. E.; Shull, C. G.; Wollan, E. O.; Apr. 20, 1951; 24 pp.; In English
Report No.(s): DE2005-4407800; No Copyright; Avail: Department of Energy Information Bridge

Thorium forms a tetragonal lower hydride of composition ThH(sub 2). The hydrides ThH(sub 2), ThD(sub 2) and ZrD(sub 2) have been studied by neutron diffraction in order that hydrogen positions could be determined. The hydrides are isomorphous, and have a deformed fluorite structure. Metal-hydrogen distances in thorium hydride are unusually large, as in UH(sub 3). Thorium and zirconium scattering amplitudes and a revised scattering amplitude for deuterium are reported.
NTIS
Crystal Structure; Crystals; Hydrides; Metal Hydrides; Neutron Diffraction; Thorium; X Ray Diffraction; Zirconium; Zirconium Compounds

20050189230 Gas Technology Inst., Des Plaines, IL, USA, Illinois Clean Coal Inst., Carterville, IL, USA
New ZnO-Based Regenerable Sulfure Sorbents for Fluid-Bad/Transport Reactor Applications
Slimane, R. B.; Abbasian, J.; Lau, F. S.; Ho, K. H.; January 2004; 20 pp.; In English
Report No.(s): DE2005-836713; No Copyright; Avail: Department of Energy Information Bridge

High-temperature desulfurization of coal-fired fuel gases is an essential process in emerging power generation technologies, such as the Integrated Gasification Combined Cycle (IGCC), aiming to improve both the efficiency and environmental performance of power generation from coal. Hot gas desulfurization may be accomplished by using solid sorbents such as oxides of those metals that form stable sulfides. The effectiveness of a desulfurizing sorbent in treating such gases is related to the predicted equilibrium partial pressure of hydrogen sulfide (H2S), which will be present in a combination of the reduced form of the sulfide and oxide phases. The external desulfurization approach consists of passing the hot fuel gases through beds of regenerable sorbents. These sorbents are invariably oxides, which are converted to sulfides during a sulfur loading stage under reducing hot fuel gas conditions and then regenerated by oxidation of the sulfides to oxides and a

by-product stream of sulfur dioxide (SO2). Regeneration is crucial to the commercial acceptance of external sorbents since they are often made from relatively expensive materials.
NTIS
Cycles; Gasification; Sorbents

20050189241 Karlsruhe Univ., Germany
Catalysis of Reduction and Oxidation Reactions for Application in Gas Particle Filters
Udron, L.; Hackel, M.; Schaub, G.; January 2005; 14 pp.; In English
Report No.(s): DE2005-836406; No Copyright; Avail: Department of Energy Information Bridge
The present study is a first part of an investigation addressing the simultaneous occurrence of oxidation and reduction reactions in catalytic filters. It has the objectives (1) to assess the state of knowledge regarding suitable (types of) catalysts for reduction and oxidation, (2) to collect and analyze published information about reaction rates of both NOx reduction and VOC oxidation, and (3) to adjust a lab-scale screening method to the requirements of an activity test with various oxidation/reduction catalysts.
NTIS
Catalysis; Oxidation; Oxidation-Reduction Reactions; Volatile Organic Compounds

20050189261 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Molecular Basis of Microbial One Carbon Metabolism. Final Progress Report
January 2002; 14 pp.; In English
Report No.(s): DE2005-823557; No Copyright; Avail: Department of Energy Information Bridge
The Gordon Research Conference (GRC) on Molecular Basis of Microbial One-Carbon Metabolism was held at Connecticut College, New London, Connecticut. Emphasis was placed on current unpublished research and discussion of the future target areas in this field.
NTIS
Carbon; Conferences; Metabolism; Microorganisms

20050189266 Department of Energy, Washington, DC USA, Department of Energy, Washington, DC USA
Molecular Engineering of Technetium and Rhenium Based Radiopharmaceuticals
January 2004; 26 pp.; In English
Report No.(s): DE2005-823848; No Copyright; Avail: Department of Energy Information Bridge
The research was based on the observation that despite the extraordinarily rich coordination chemistry of technetium and rhenium and several notable successes in reagent design, the extensive investigations by numerous research groups on a variety of N(sub 2)S(sub 2) and N(sub 3)S donor type ligands and on HYNIC have revealed that the chemistries of these ligands with Tc and Re are rather complex, giving rise to considerable difficulties in the development of reliable procedures for the development of radiopharmaceutical reagents.
NTIS
Pharmacology; Radioactive Isotopes; Rhenium; Technetium

20050189270 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Water and Aqueous Solutions. Final Progress Report
January 2004; 1 pp.; In English
Report No.(s): DE2005-823983; No Copyright; Avail: Department of Energy Information Bridge
The Gordon Research Conference (GRC) on Water & Aqueous Solutions was held at Holderness School, New Hampshire, 8/4/02 thru 8/9/02. Emphasis was placed on current unpublished research and discussion of the future target areas in this field.
NTIS
Aqueous Solutions; Conferences; Water

20050189272 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Chemical Reactions at Surfaces. Final Progress Report
January 2004; 14 pp.; In English
Report No.(s): DE2005-824011; No Copyright; Avail: Department of Energy Information Bridge
The Gordon Research Conference (GRC) on Chemical Reactions at Surfaces was held at Holiday Inn, Ventura, California,

2/16-21/03. Emphasis was placed on current unpublished research and discussion of the future target areas in this field.
NTIS
Chemical Reactions; Conferences

20050192039 New Orleans Univ., LA, USA, Los Alamos National Lab., NM USA
Synthetic and Thermodynamic Invesitgations of Ancillary Ligand Influence on Catalytic Organometallic Systems
Orleans, S. P.; January 2003; 10 pp.; In English
Report No.(s): DE2005-821151; No Copyright; Avail: Department of Energy Information Bridge

During the grant period we have been involved in synthesizing and experimentally determining solution enthalpy values associated with partially fluorinated ligands. This has lead to the publication of manuscripts dealing with synthetic, calorimetric and catalytic behavior of partially fluorinated ligands. The collaboration with Los Alamos researchers has lead to the publication of catalytic results in sc CO(sub 2) which have proven very interesting. Furthermore, we have also examined ligands that behave as phosphine mimics. The N-heterocyclic carbenes have been explored as alternatives for tertiary phosphines and have resulted in the design and construction of efficient palladium and nickel system capable of performing C-C and C-N cross coupling reactions. The initial studies in this areas were made possible by exploratory work conducted under the DOE/EPSCoR grant.
NTIS
Catalysts; Ligands; Organometallic Compounds; Thermodynamics

20050192046 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Chemical Physics Summer School
January 2002; 16 pp.; In English
Report No.(s): DE2005-823564; No Copyright; Avail: Department of Energy Information Bridge

This chemical physics summer school will provide a basic survey of current theoretical and experimental techniques for chemistry and physics graduate students, post doctoral fellows and advanced senior undergraduate students. The lectures will emphasize physically-motivated approximations and the connection with current experiments. Lecturers will discuss what aspects have made their work so insightful and influential and what part may be transferable to other quite different problems and so speak to a large body of students in various fields of theory. One of the major accomplishments of the series of schools organized by Lowdin in the sixties and seventies was that they created a sense of community in quantum chemistry.
NTIS
Conferences; Schools; Summer

20050192048 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Multiphoton Processes
January 2002; 14 pp.; In English
Report No.(s): DE2005-823572; No Copyright; Avail: Department of Energy Information Bridge

The Gordon Research Conference (GRC) on MULTIPHOTON PROCESSES was held at Tilton School, Tilton, NH. Emphasis was placed on current unpublished research and discussion of the future target areas in this field.
NTIS
Conferences; Photons

20050192052 Department of Energy, Washington, DC USA
Combined Extraction of Cesium, Strontium, and Actinides from Alkaline Media: An Extension of the Caustic-Side Solvent Extraction (CSSX) Process Technology
January 2005; 12 pp.; In English
Report No.(s): DE2005-836576; No Copyright; Avail: Department of Energy Information Bridge

The wastes present at DOE long-term storage sites are usually highly alkaline, and because of this, much of the actinides in these wastes are in the sludge phase. Enough actinide materials still remain in the supernatant liquid that they require separation followed by long-term storage in a geological repository. The removal of these metals from the liquid waste stream would permit their disposal as low-level waste and dramatically reduce the volume of high-level wastes. The actinide

extraction and recovery systems currently in place presently are not optimal, and the alkaline conditions and presence of other radioactive metals, Cs and Sr, complicate efficient extraction.
NTIS
Actinide Series; Alkalies; Cesium; Extraction; Solvent Extraction; Strontium

20050192225 NASA Glenn Research Center, Cleveland, OH, USA
Resin Transfer Moldable Polyimides Developed for High-Temperature Applications
Meador, Mary Ann; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

High-temperature polyimides, such as PMR 15 (which was developed at the NASA Glenn Research Center at Lewis Field), are becoming an increasingly important class of materials for a variety of aerospace applications, such as aircraft engine components and propulsion and airframe components for reusable launch vehicles (RLV s). Because of their high specific strength and low density, use of these materials in place of more traditional aerospace materials, such as titanium, can significantly reduce component and vehicle weight, leading to reductions in fuel consumption (and pollutants), increases in payload and passenger capacity, and improvements in vehicle performance.
Derived from text
Polyimides; Resins; High Temperature

20050192278 National Oceanic and Atmospheric Administration, Seattle, WA, USA
Reactive Separations Via a Hydrothermally Stable Hydrogen Selective Membrane
Ciora, R. J.; Liu, P.; Oct. 29, 2002; 20 pp.; In English
Report No.(s): DE2005-824152; No Copyright; Avail: Department of Energy Information Bridge

In this SBIR Phase I program, we have successfully completed the fabrication of SiC-based hydrogen selective membranes suitable for use as a membrane reactor for steam-methane reforming applications. Hydrothermal stability was performed for selected membrane to demonstrate their stability for approx. 50 hours under the proposed reforming condition. In addition, several mechanistic study was conducted to elucidate the SiC membrane formation mechanism. This understanding will facilitate membrane optimization work to be proposed for the Phase II study. The reaction study was postponed to the Phase II study.
NTIS
Hydrogen; Membranes; Reactivity

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METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

20050186902 NASA Glenn Research Center, Cleveland, OH, USA
Thermal and Mechanical Property Characterization of the Advanced Disk Alloy LSHR
Gabb, Timothy P.; Gayda, John; Telesman, Jack; Kantzos, Peter T.; June 2005; 82 pp.; In English
Contract(s)/Grant(s): WBS 22-079-30-09
Report No.(s): NASA/TM-2005-213645; E-15133; No Copyright; Avail: CASI; A05, Hardcopy

A low solvus, high refractory (LSHR) powder metallurgy disk alloy was recently designed using experimental screening and statistical modeling of composition and processing variables on sub-scale disks to have versatile processing-property capabilities for advanced disk applications. The objective of the present study was to produce a scaled-up disk and apply varied heat treat processes to enable full-scale demonstration of LSHR properties. Scaled-up disks were produced, heat treated, sectioned, and then machined into specimens for mechanical testing. Results indicate the LSHR alloy can be processed to produce fine and coarse grain microstructures with differing combinations of strength and time-dependent mechanical properties, for application at temperatures exceeding 1300 F.
Author
Powder Metallurgy; Refractories; Statistical Analysis; Microstructure

20050186903 NASA Glenn Research Center, Cleveland, OH, USA

Forging of Advanced Disk Alloy LSHR

Gabb, Timothy P.; Gayda, John; Falsey, John; June 2005; 134 pp.; In English

Contract(s)/Grant(s): WBS 22-079-30-09

Report No.(s): NASA/TM-2005-213649; E-15138; No Copyright; Avail: CASI; A07, Hardcopy

The powder metallurgy disk alloy LSHR was designed with a relatively low gamma precipitate solvus temperature and high refractory element content to allow versatile heat treatment processing combined with high tensile, creep and fatigue properties. Grain size can be chiefly controlled through proper selection of solution heat treatment temperatures relative to the gamma precipitate solvus temperature. However, forging process conditions can also significantly influence solution heat treatment-grain size response. Therefore, it is necessary to understand the relationships between forging process conditions and the eventual grain size of solution heat treated material. A series of forging experiments were performed with subsequent subsolvus and supersolvus heat treatments, in search of suitable forging conditions for producing uniform fine grain and coarse grain microstructures. Subsolvus, supersolvus, and combined subsolvus plus supersolvus heat treatments were then applied. Forging and subsequent heat treatment conditions were identified allowing uniform fine and coarse grain microstructures. Author

Powder Metallurgy; Microstructure; Heat Treatment; Refractories; Metal Powder

20050187011 NASA Lewis Research Center, Cleveland, OH, USA, Ohio Aerospace Inst., OH, USA

Monte Carlo Simulation of Alloy Design Techniques: Fracture and Welding Studied Using the BFS Method for Alloys

Bozzolo, Guillermo H.; Good, Brian; Noebe, Ronald D.; Honecy, Frank; Abel, Phillip; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Large-scale simulations of dynamic processes at the atomic level have developed into one of the main areas of work in computational materials science. Until recently, severe computational restrictions, as well as the lack of accurate methods for calculating the energetics, resulted in slower growth in the area than that required by current alloy design programs. The Computational Materials Group at the NASA Lewis Research Center is devoted to the development of powerful, accurate, economical tools to aid in alloy design. These include the BFS (Bozzolo, Ferrante, and Smith) method for alloys (ref. 1) and the development of dedicated software for large-scale simulations based on Monte Carlo- Metropolis numerical techniques, as well as state-of-the-art visualization methods. Our previous effort linking theoretical and computational modeling resulted in the successful prediction of the microstructure of a five-element intermetallic alloy, in excellent agreement with experimental results (refs. 2 and 3). This effort also produced a complete description of the role of alloying additions in intermetallic binary, ternary, and higher order alloys (ref. 4).
Author

Monte Carlo Method; Alloying; Ternary Alloys; Intermetallics; Microstructure; Simulation

20050187019 NASA Lewis Research Center, Cleveland, OH, USA

10 000-hr Cyclic Oxidation Behavior of 68 High-Temperature Co-, Fe-, and Ni- Base Alloys Evaluated at 982 deg. C (1800 deg. F)

Barrett, Charles A.; Research and Technology 1999; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Power systems with operating temperatures in the range of 815 to 982 C (1500 to 1800 F) frequently require alloys that can operate for long times at these temperatures. A critical requirement is that these alloys have adequate oxidation resistance. The alloys used in these power systems require thousands of hours of operating life with intermittent shutdown to room temperature. Intermittent power plant shutdowns, however, offer the possibility that the protective scale will tend to spall (i.e., crack and flake off) upon cooling, increasing the rate of oxidative attack in subsequent heating cycles. Thus, it is critical that candidate alloys be evaluated for cyclic oxidation behavior. It was determined that exposing test alloys to ten 1000-hr cycles in static air at 982 10 000-hr Cyclic Oxidation Behavior of 68 High-Temperature Co-, Fe-, and Ni-Base Alloys Evaluated at 982 C (1800 F) could give a reasonable simulation of long-time power plant operation. Iron- (Fe-), nickel- (Ni-), and cobalt- (Co-) based high-temperature alloys with sufficient chromium (Cr) and/or aluminum (Al) content can exhibit excellent oxidation resistance. The protective oxides formed by these classes of alloys are typically Cr2O3 and/or Al2O3, and are usually influenced by their Cr, or Cr and Al, content. Sixty-eight Co-, Fe-, and Ni-base high-temperature alloys, typical of those used at this temperature or higher, were used in this study. At the NASA Lewis Research Center, the alloys were tested and compared on the basis of their weight change as a function of time, x-ray diffraction of the protective scale composition, and the physical appearance of the exposed samples. Although final appearance and x-ray diffraction of the final scale products were two factors used to evaluate the oxidation resistance of each alloy, the main criterion was the oxidation kinetics inferred

from the specific weight change versus time data. These data indicated a range of oxidation behavior including parabolic (typical of isothermal oxidation), paralinear, linear, and mixed-linear kinetics.
Derived from text
Oxidation Resistance; Heat Resistant Alloys; Cobalt Alloys; Iron Alloys; Nickel Alloys

20050187020 NASA Lewis Research Center, Cleveland, OH, USA
Single-Crystal NiAl-X Alloys Tested for Hot Corrosion
Nesbitt, James A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Single-crystal nickel aluminide (NiAl) has been investigated extensively throughout the last several years as a potential structural material in aero-gas turbine engines. The attractive features of NiAl in comparison to Ni-base superalloys include a higher melting point, lower density, higher thermal conductivity, and excellent oxidation resistance. However, NiAl suffers from a lack of ductility and fracture toughness at low temperatures and a low creep strength at high temperatures. Alloying additions of hafnium (Hf), gallium (Ga), titanium (Ti), and chromium (Cr) have each shown some benefit to the mechanical properties over that of the binary alloy. However, the collective effect of these alloying additions on the environmental resistance of NiAl-X was unclear. Hence, the present study was undertaken to examine the hot corrosion behavior of these alloys. A companion study examined the cyclic oxidation resistance of these alloys. Several single-crystal NiAl-X alloys (where X is Hf, Ti, Cr, or Ga) underwent hot corrosion testing in a Mach 0.3 burner rig at the NASA Lewis Research Center. Samples were tested for up to 300 1-hr cycles at a temperature of 900 C. It was found that increasing the Ti content from 1 to 5 at.% degraded the hot corrosion behavior. This decline in the behavior was reflected in high weight gains and large corrosion mound formation during testing (see the figures). However, the addition of 1 to 2 at.% Cr to alloys containing 4 to 5 at.% Ti appeared to greatly reduce the susceptibility of these alloys to hot corrosion attack and negated the deleterious effect of the increased Ti addition.
Author
Nickel Aluminides; Single Crystals; Hot Corrosion; Thermal Conductivity; Binary Alloys; Corrosion Tests; Fracture Strength; Heat Resistant Alloys

20050187042 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Massachusetts Inst. of Tech., Cambridge, MA, USA
Synthesis and Optical Properties of II-O-VI Highly Mismatched Alloys
Yu, K. M.; Walukiewicz, W.; Scarpulla, M. A.; Dubon, O. D.; Becla, P.; January 2005; 36 pp.; In English
Report No.(s): DE2005-836378; No Copyright; Avail: Department of Energy Information Bridge

We have synthesized ternary and quaternary diluted II-VI oxides using the combination of O ion implantation and pulsed laser melting. CdOxTe1-x thin films with x up to 0.015, and the energy gap reduced by 150 meV were formed by O+-implantation in CdTe followed by pulsed laser melting. Quaternary Cd0.6Mn0.4OxTe1-x and Zn0.88Mn0.12OxTe1-x with mole fraction of incorporated O as high as 0.03 were also formed. The enhanced O incorporation in Mn-containing alloys is believed to be due to the formation of relatively strong Mn-O bonds. Optical transitions associated with the lower (E-) and upper (E+) conduction subbands resulting from the anticrossing interaction between the localized O states and the extended conduction states of the host are clearly observed in these quaternary diluted II-VI oxides. These alloys fulfill the criteria for a multiband semiconductor that has been proposed as a material for making high efficiency, singlejunction solar cells.
NTIS
Optical Properties; Oxides

20050187044 California Univ., Berkeley, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Cornell Univ., Ithaca, NY, USA
Universal Bandgap Bowing in Group III Nitride Alloys
Wu, J.; Walukiewicz, W.; Yu, K. M.; Lu, H.; Schaff, W. J.; January 2004; 16 pp.; In English
Report No.(s): DE2005-835986; No Copyright; Avail: Department of Energy Information Bridge

The energy gaps of MBE-grown wurtzite-structure In(sub 1-x)Al(sub x)N alloys with x less than or equal to 0.25 have been measured by absorption and photoluminescence experiments. The results are consistent with the recent discovery of a narrow bandgap of approximately 0.8 eV for InN. A bowing parameter of 3 eV was determined from the composition dependence of these bandgaps. Combined with previously reported data of InGaN and AlGaN, these results show a universal

relationship between the bandgap variations of group III nitride alloys and their compositions.
NTIS
Energy Gaps (Solid State); Nitrides; Molecular Beam Epitaxy

20050188485 NASA Lewis Research Center, Cleveland, OH, USA
Effects Investigated of Ambient High-Temperature Exposure on Alumina-Titania High-Emittance Surfaces for Solar Dynamic Systems
deGroh, Kim K.; Smith, Daniela C.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Solar-dynamic space power systems require durable, high-emittance surfaces on a number of critical components, such as heat receiver interior surfaces and parasitic load radiator (PLR) elements. An alumina-titania coating, which has been evaluated for solar-dynamic heat receiver canister applications, has been chosen for a PLR application (an electrical sink for excess power from the turboalternator/compressor) because of its demonstrated high emittance and high-temperature durability in vacuum. Under high vacuum conditions (+/- 10(exp -6) torr), the alumina-titania coating was found to be durable at temperatures of 1520 F (827 C) for approx. 2700 hours with no degradation in optical properties. This coating has been successfully applied to the 2-kW solar-dynamic ground test demonstrator at the NASA Lewis Research Center, to the 500 thermal-energy-storage containment canisters inside the heat receiver and to the PLR radiator. The solar-dynamic demonstrator has successfully operated for over 800 hours in Lewis large thermal/vacuum space environment facility, demonstrating the feasibility of solar-dynamic power generation for space applications.
Derived from text
High Temperature; Solar Activity; Aluminum Oxides; Titania; Emittance; Coating

20050188540 NASA Lewis Research Center, Cleveland, OH, USA
Resistance of Titanium Aluminide to Domestic Object Damage Assessed
Lerch, Bradley A.; Draper, Susan L.; Pereira, J. Michael; Nathal, Michael V.; Austin, Curt; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A team consisting of GE Aircraft Engines, Precision Cast Parts, Oremet, and Chromalloy were awarded a NASA-sponsored Aerospace Industry Technology Program (AITP) to develop a design and manufacturing capability that will lead to the engine test demonstration and eventual implementation of a ?-Ti-47Al-2Nb-2Cr (at. %) titanium aluminide (TiAl) low-pressure turbine blade into commercial service. One of the main technical risks of implementing TiAl low-pressure turbine blades is the poor impact resistance of TiAl in comparison to the currently used nickel-based superalloy. The impact resistance of TiAl is being investigated at the NASA Lewis Research Center as part of the Aerospace Industry Technology Program and the Advanced High Temperature Engine Materials Program (HITEMP). The overall objective of this work is to determine the influence of impact damage on the high cycle fatigue life of TiAl-simulated low-pressure turbine blades. To this end, impact specimens were cast to size in a dog-bone configuration and given a typical processing sequence followed by an exposure to 650 degrees Celsius for 20 hours to simulate embrittlement at service conditions. Then, the specimens were impacted at 260 degrees Celsius under a 69-MPa load. Steel projectiles with diameters 1.6 and 3.2 mm were used to impact the specimens at 90 degrees Celsius to the leading edge. Two different impact energies (0.74 and 1.5 joules) were used to simulate fairly severe domestic object damage on a low-pressure turbine blade.
Derived from text
Titanium Aluminides; Titanium Alloys; Heat Resistant Alloys

20050189158 Naval Postgraduate School, Monterey, CA USA
Grain Size Control in AA5083 by Thermomechanical Processing (TMP): The Role of Dispersed Particles
Orellano, Ramiro E., Jr; Sep. 2003; 109 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434673; No Copyright; Avail: Defense Technical Information Center (DTIC)

Superplasiticity in Aluminum alloys allows for the economical forming of components of complex shapes while retaining the high-strength and stiffness-to-weight ratios characteristic of alloys used in automotive, aerospace and military applications. Superplastic materials require fine grains with high-angle boundaries having resistance to failure by cavitation. This study was designed to achieve improved control of microstructure of Continuously Cast (CC) AA 5083 utilizing the Particle Stimulated Nucleation (PSN) model as a guide. The studies included a variety of overaging parameters in the thermomechanical process (TMP), followed by a constant processing strain and a subsequent recrystallization annealing treatment. The resulting material was analyzed using optical microscopy, and backscatter electron (BSE) and orientation imaging microscopy (OIM) methods

to evaluate the effect of the processing on the grain size and the dispersion of particles.
DTIC
Grain Size; Superplasticity; Thermodynamics; Thermomechanical Treatment

20050189216 Institute of Nuclear Energy Research, Lung-Tan, Taiwan, Province of China
Study for Recycling of Norm Contaminated Steel Scraps from Steel Industry
Tsai, K. F.; Lee, Y. S.; January 2003; 10 pp.; In English
Report No.(s): DE2005-825862; No Copyright; Avail: Department of Energy Information Bridge
Since 1994, most of the major steel industries in Taiwan have installed portal monitor to detect the abnormal radiation in metal scrap feed. As a result, the discovery of NORM (Naturally Occurring Radioactive Material) has increased in recent years. In order to save the natural resources and promote radiation protection, an experimental melting process for the NORM contaminated steel scraps was carried out by the Institute of Nuclear Energy Research (INER) Taiwan, ROC. The experimental melting process has a pretreatment step that includes a series of cutting and removal of scales, sludge, as well as combustible and volatile materials on/in the steel scraps. After pretreatment the surface of the steel scraps are relatively clean. Then the scraps are melted by a pilot-type induction furnace. This experiment finally produced seven ingots with a total weight of 2,849 kg and 96.8% recovery. All of the surface dose rates are of the background values. The activity concentrations of these ingots are also below the regulatory criteria. Thus, these NORM-bearing steel scraps are ready for recycling. This study has been granted by the regulatory authority.
NTIS
Contamination; Industries; Metals; Radioactive Wastes; Recycling; Scrap; Steels; Energy Technology

20050189235 Department of Energy, Albany, OR, USA
Oxidation and Sulfidation Resistant Alloys with Silicon Additions
Dunning, J. S.; Alman, D. E.; January 2005; 14 pp.; In English
Report No.(s): DE2005-835698; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
Chromium Alloys; Oxidation; Silicon; Sulfidation

20050192029 Lawrence Livermore National Lab., Livermore, CA USA
Shear Modeling: Thermoelasticity at High Temperature and Pressure for Tantalum
Orlikowski, D.; Soderlind, P.; Moriarty, J. A.; Aug. 27, 2004; 10 pp.; In English
Report No.(s): DE2005-15014354; UCRL-PROC-206259; No Copyright; Avail: Department of Energy Information Bridge
For large-scale constitutive strength models the shear modulus is typically assumed to be linearly dependent on temperature. However, for materials compressed beyond the Hugoniot or in regimes where there is very little experimental data, accurate and validated models must be used. To this end, we present here a new methodology that fully accounts for electron- and ion-thermal contributions to the elastic moduli over broad ranges of temperature (\h20,000 K) and pressure (\h10 Mbar). In this approach, the full potential linear muffin-tin orbital (FP-LMTO) method for the cold and electron-thermal contributions is closely coupled with ion-thermal contributions. For the latter two separate approaches are used. In one approach, the quasi-harmonic, ion-thermal contribution is obtained through a Brillouin zone sum of strain derivatives of the phonons, and in the other a full anharmonic ion-thermal contribution is obtained directly through Monte Carlo (MC) canonical distribution averages of strain derivatives on the multi-ion potential itself.
NTIS
High Temperature; Tantalum; Thermoelasticity

20050192061 Pennsylvania State Univ., University Park, PA, USA
Improved Tubulars for Better Economics in Deep Gas Well Drilling using Microwave Technology. Annual Report, October 1, 2003-February 28, 2005
Agrawal, D.; Gigl, P.; Dennis, M.; Stanley, R.; Mar. 2005; 24 pp.; In English
Report No.(s): DE2005-838119; No Copyright; Avail: Department of Energy Information Bridge
The main objective of the research program has been to improve the rate-of-penetration in deep hostile environments by improving the life cycle and performance of coiled-tubing, an important component of a deep well drilling system for oil and gas exploration, by utilizing the latest developments in the microwave materials technology. Originally, it was proposed to accomplish this by developing an efficient and economically viable continuous microwave process to sinter continuously

formed/extruded steel powder for the manufacture of seamless coiled tubing and other tubular products. However, based on the results and faced with insurmountable difficulties in the extrusion and de-waxing processes, the approach of achieving the goals of the program has been slightly changed. In the continuation proposal an approach of microwave sintering combined with Cold Isostatic Press (CIP) and joining (by induction or microwave) is adopted. This process can be developed into a semi-continuous sintering process if the CIP can produce parts fast enough to match the microwave sintering rates. Originally, the entire program was spread over three phases with the following goals: Phase I: Demonstration of the feasibility concept of continuous microwave sintering process for tubular steel products. Phase II: Design, building and testing of a prototype microwave system which shall be combined with a continuous extruder for steel tubular objects. Phase III: Execution of the plan for commercialization of the technology by one of the industrial partners. However, since some of the goals of the phase I were not completed, an extension of nine months was granted and we continued extrusion experiments, designed and built semicontinuous microwave sintering unit.
NTIS
Drilling; Economics; Microwave Equipment; Natural Gas; Pipes (Tubes); Steels; Wells

20050192146 NASA Lewis Research Center, Cleveland, OH, USA
Deformation Behaviors of HIPped Foil Compared with Those of Sheet Titanium Alloys
Castelli, Michael G.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Micromechanics-based modeling of composite material behaviors requires an accurate assessment of the constituent properties and behaviors. For the specific case of continuous-fiber-reinforced metal matrix composites (MMC's) manufactured from a foil/fiber/foil process, much emphasis has been placed on characterizing foil-based matrix materials that have been fabricated in the same way as the composite. Such materials are believed to yield mechanical properties and behaviors that are representative of the matrix constituent within the composite (in situ matrix). Therefore, these materials are desired for micromechanics modeling input. Unfortunately, such foils are extremely expensive to fabricate and procure because of the labor-intensive rolling process needed to produce them. As a potential solution to this problem that would maintain appropriately representative in situ properties, the matrix constituent could be characterized with sheet-based materials, which are considerably less expensive to manufacture than foils, are more readily procured, and result in fewer plies to obtain a desired panel thickness. The critical question is, however, does the consolidated sheet material exhibit the same properties and behaviors as do the consolidated foils? Researchers at NASA Lewis Research Center's Life Prediction Branch completed a detailed experimental investigation to answer this question for three titanium alloys commonly used in metal matrix composite form.
Derived from text
Deformation; Metal Sheets; Titanium Alloys; Metal Matrix Composites; Metal Foils

20050192158 NASA Glenn Research Center, Cleveland, OH, USA
Third-Generation TiAl Alloy Tested: Exhibits Promising Properties for Rotating Components
Draper, Susan L.; Locci, Ivan E.; Whittenberger, J. Daniel; Lerch, Bradley A.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Revolutionary Turbine Accelerator/Turbine-Based Combined Cycle (RTA/TBCC) Program for the next-generation launch vehicle has targeted gamma titanium aluminide as a potential compressor and structural material. Because of the high compressor inlet and exit temperatures, the TBCC engine requires higher temperature materials than conventional Ti alloys, and because of its stringent thrust-to-weight requirements, the engine requires low-density material to be utilized wherever possible. Third-generation gamma alloys offer higher temperature capability along with low density and high stiffness. A high-temperature, high-strength *-TiAl alloy with a high Nb-content (Gamma MET PX1) was selected for evaluation. The microstructure and mechanical properties of Gamma Met PX (GMPX) in both the as-extruded and a lamellar heat-treated condition and the influence of the microstructure on the tensile, creep, and fatigue properties were investigated in-house.
Derived from text
Titanium Alloys; Titanium Aluminides; Niobium; Microstructure; Creep Properties

20050192166 NASA Glenn Research Center, Cleveland, OH, USA, Ohio Aerospace Inst., OH, USA
Conductivity of GRCop-42 Alloy Enhanced
Ellis, David L.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

GRCop-84, a material developed at the NASA Glenn Research Center, has shown considerable promise for staged

combustion rocket engine cycles such as the Space Shuttle Main Engine. However, for an expander cycle rocket engine, the transfer of heat to the fuel is a paramount factor in determining the efficiency of the engine. Examples of current and potential future expander cycle rocket engines are the Pratt & Whitney RL-10, RL-60, and RLX engines. Development of a higher conductivity version of GRCop-84 was undertaken to meet these needs. All expander cycle engines need a main combustion chamber liner with the maximum possible thermal conductivity. In an effort at Glenn to trade some of the greatly increased mechanical properties of GRCop-84 for improved thermal conductivity, the amounts of chromium and niobium were halved. The new Cu-4 at.% Cr-2 at.% Nb alloy was designated GRCop-42.
Author
Copper Alloys; Thermal Conductivity; Rocket Linings

20050192173 NASA Glenn Research Center, Cleveland, OH, USA, Ohio Aerospace Inst., OH, USA
GRCop-84 Scaled Up for Production
Ellis, David L.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

GRCop-84 (Cu-8 at.% Cr-4 at.% Nb) was developed at the NASA Glenn Research Center for use in regeneratively cooled rocket engine main combustion chamber liners. The alloy has demonstrated high elevated-temperature strength, excellent creep resistance, long low-cycle-fatigue lives, low thermal expansion, and good thermal conductivity on a laboratory scale. The combination of properties has led to interest from the Rocketdyne Division of Boeing, Aerojet, and Pratt & Whitney for their new engines. Under the Space Launch Initiative/Next Generation Launch Technology program, GRCop-84 is being taken out of the laboratory and put into a full-scale production environment.
Derived from text
Copper Alloys; Rocket Linings; Powder Metallurgy; Preforms

20050192177 NASA Glenn Research Center, Cleveland, OH, USA
Potential High-Temperature Shape-Memory Alloys Identified in the Ti(Ni,Pt) System
Noebe, Ronald D.; Biles, Tiffany A.; Garg, Anita; Nathal, Michael V.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

'Shape memory' is a unique property of certain alloys that, when deformed (within certain strain limits) at low temperatures, will remember and recover to their original predeformed shape upon heating. It occurs when an alloy is deformed in the low-temperature martensitic phase and is then heated above its transformation temperature back to an austenitic state. As the material passes through this solid-state phase transformation on heating, it also recovers its original shape. This behavior is widely exploited, near room temperature, in commercially available NiTi alloys for connectors, couplings, valves, actuators, stents, and other medical and dental devices. In addition, there are limitless applications in the aerospace, automotive, chemical processing, and many other industries for materials that exhibit this type of shape-memory behavior at higher temperatures. But for high temperatures, there are currently no commercial shape-memory alloys. Although there are significant challenges to the development of high-temperature shape-memory alloys, at the NASA Glenn Research Center we have identified a series of alloy compositions in the Ti-Ni-Pt system that show great promise as potential high-temperature shape-memory materials.
Author
Shape Memory Alloys; Heat Resistant Alloys; Titanium Alloys

20050192197 NASA Glenn Research Center, Cleveland, OH, USA
Very Long Term Oxidation of Titanium Aluminides Investigated
Locci, Ivan E.; Brady, Michael P.; Smialek, James L.; Retallick, William B.; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Titanium aluminides (TiAl) are of great interest for intermediate-temperature (600 to 850 C) aerospace and power-generation applications because they offer significant weight savings over today's nickel alloys. TiAl alloys are being investigated for low-pressure turbine blade applications, exhaust nozzle components, and compressor cases in advanced subsonic and supersonic engines. Significant progress has been made in understanding the fundamental aspects of the oxidation behavior of binary TiAl alloys. However, most of this work has concentrated on short term (\h1000 hr), high-temperature (900 to 1000 C) exposures. Also, there is not much data available in the literature regarding the oxidation behavior of the quaternary and higher order engineering alloys. This is especially true for the very long term, low-temperature conditions likely to be experienced during aerospace applications. An investigation at the NASA Glenn Research Center at Lewis Field was undertaken to characterize the long-term oxidation behavior of various model and advanced titanium

aluminides for periods up to 7000 hr at 704 C in air using a high-resolution field emission scanning electron microscope. Also, a unique surface treatment technique developed to improve the oxidation resistance of TiAl was evaluated. The alloys included in this investigation are listed in the table. The table also shows typical alloy compositions and the specific weight changes and scale thickness measured for each alloy after exposure to 700 C for 7000 hr in air.
Author
Titanium Aluminides; Titanium Alloys; Long Term Effects; Oxidation; High Temperature Tests

20050192203 NASA Glenn Research Center, Cleveland, OH, USA
Directionally Solidified NiAl-Based Alloys Studied for Improved Elevated-Temperature Strength and Room-Temperature Fracture Toughness
Whittenberger, J. Daniel; Raj, Sai V.; Locci, Ivan E.; Salem, Jonathan A.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Efforts are underway to replace superalloys used in the hot sections of gas turbine engines with materials possessing better mechanical and physical properties. Alloys based on the intermetallic NiAl have demonstrated potential; however, they generally suffer from low fracture resistance (toughness) at room temperature and from poor strength at elevated temperatures. Directional solidification of NiAl alloyed with both Cr and Mo has yielded materials with useful toughness and elevated-temperature strength values. The intermetallic alloy NiAl has been proposed as an advanced material to extend the maximum operational temperature of gas turbine engines by several hundred degrees centigrade. This intermetallic alloy displays a lower density (approximately 30-percent less) and a higher thermal conductivity (4 to 8 times greater) than conventional superalloys as well as good high-temperature oxidation resistance. Unfortunately, unalloyed NiAl has poor elevated temperature strength (approximately 50 MPa at 1027 C) and low room-temperature fracture toughness (about 5 MPa). Directionally solidified NiAl eutectic alloys are known to possess a combination of high elevated-temperature strength and good room-temperature fracture toughness. Research has demonstrated that a NiAl matrix containing a uniform distribution of very thin Cr plates alloyed with Mo possessed both increased fracture toughness and elevated-temperature creep strength. Although attractive properties were obtained, these alloys were formed at low growth rates (greater than 19 mm/hr), which are considered to be economically unviable. Hence, an investigation was warranted of the strength and toughness behavior of NiAl-(Cr,Mo) directionally solidified at faster growth rates. If the mechanical properties did not deteriorate with increased growth rates, directional solidification could offer an economical means to produce NiAl-based alloys commercially for gas turbine engines. An investigation at the NASA Glenn Research Center at Lewis Field was undertaken to study the effect of the directional solidification growth rate on the microstructure, room temperature fracture toughness, and strength at 1027 C of a Ni-33Al-31Cr-3Mo eutectic alloy. The directionally solidified rates varied between 7.6 and 508 millimeters per hour Essentially fault-free, alternating (Cr, Mo)/NiAl lamellar plate microstructures (left photograph) were formed during growth at and below 12.7 mm/hr, whereas cellular microstructures (right photograph) with the (Cr, Mo) phase in a radial spokelike pattern were developed at faster growth rates. The compressive strength at 1027 C continuously increased with increasing growth rate and did not indicate a maxima as was reported for directionally solidified Ni-33Al-34Cr. Surprisingly, samples with the lamellar plate microstructure (left photograph) possessed a room-temperature fracture toughness of approximately 12 MPa(sup square root of m), whereas all the alloys with a cellular microstructure had a toughness of about 17 MPa(sup square root of m). These results are significant since they clearly demonstrate that Ni-33Al-31Cr-3Mo can be directionally solidified at much faster growth rates without any observable deterioration in its mechanical properties. Thus, the potential to produce strong, tough NiAl-based eutectics at commercially acceptable growth rates exists. Additional testing and alloy optimization studies are underway.
Derived from text
Directional Solidification (Crystals); Fracture Strength; Mechanical Properties; Room Temperature; Nickel Alloys; Aluminum Alloys; High Temperature; Eutectic Alloys; Intermetallics

20050192204 NASA Glenn Research Center, Cleveland, OH, USA
Creep Properties of NiAl-1Hf Single Crystals Re-Investigated
Whittenberger, J. Daniel; Locci, Ivan E.; Darolia, Ram; Bowman, Randy R.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NiAl-1Hf single crystals have been shown to be quite strong at 1027 C, with strength levels approaching those of advanced Ni-based superalloys. Initial testing, however, indicated that the properties might not be reproducible. Study of the 1027 C creep behavior of four different NiAl-1Hf single-crystal ingots subjected to several different heat treatments indicated that strength lies in a narrow band. Thus, we concluded that the mechanical properties are reproducible. Recent investigations of the intermetallic NiAl have confirmed that minor alloying additions combined with single-crystal growth technology can

produce elevated temperature strength levels approaching those of Ni-based superalloys. For example, General Electric alloy AFN 12 {Ni-48.5(at.%) Al-0.5Hf-1Ti-0.05Ga} has a creep rupture strength equivalent to Rene 80 combined with a approximately 30-percent lower density, a fourfold improvement in thermal conductivity, and the ability to form a self-protective alumina scale in aggressive environments. Although the compositions of strong NiAl single crystals are relatively simple, the microstructures are complex and vary with the heat treatment and with small ingot-toingot variations in the alloy chemistry. In addition, initial testing suggested a strong dependence between microstructure and creep strength. If these observations were true, the ability to utilize NiAl single-crystal rotating components in turbine machinery could be severely limited. To investigate the possible limitations in the creep response of high-strength NiAl single crystals, the NASA Glenn Research Center at Lewis Field initiated an in depth investigation of the effect of heat treatment on the microstructure and subsequent 1027 C creep behavior of [001]-oriented NiAl-1Hf with a nominal chemistry of Ni-47.5Al-1Hf-0.5Si. This alloy was selected since four ingots, grown over a number of years and possessing slightly different compositions, were available for study. Specimens taken from the ingots were subjected to several heat treatment schedules, examined by transmission electron microscopy, and tested in both compression and tension. An example of the microstructure found in a [001]-oriented NiAl-1Hf specimen after a solution treatment at 1317 C for 50 hr followed by air cooling is illustrated in the image on the left, where the NiAl matrix contains a uniform distribution of nanometer-scale Gphase (Ni16Hf6Si7) precipitates. Other heat treating schedules produced microstructures with nanometer-sized G-phase cubes and plates or, in an extreme case, produced a microstructure with all the G-phase converted to Heusler (Ni2AlHf) particles. The results of 1027 C creep strength and strain rate testing are illustrated which summarizes data from tensile and compressive testing of samples cut from all four NiAl-1Hf ingots and subjected to a variety of heat treatment schedules. With one exception, all the strength values lie in a narrow band that spans six orders of magnitude in strain rate. The only factor that produced results outside of this band was the heat treatment schedule that dissolved all the G-phase and replaced it with Heusler precipitates. The results portrayed in this figure lead to the important practical conclusion that the elevated-temperature creep properties of NiAl-1Hf single crystals are reproducible and are not affected by small variations in alloy chemistry from ingot to ingot or by different initial distributions of G-phase in the heat-treated alloy. The only variable in this study that produced a significant and delerious effect on mechanical strength was a post-solution heat treatment that lead to the complete disappearance of the G-phase in favor of Heusler precipitates.

Author

Creep Properties; Heat Resistant Alloys; Intermetallics; Mechanical Properties; Single Crystals; Nickel Aluminides; Hafnium

20050192217 NASA Glenn Research Center, Cleveland, OH, USA, Ohio Aerospace Inst., OH, USA

Atomistic Method Applied to Computational Modeling of Surface Alloys

Bozzolo, Guillermo H.; Abel, Phillip B.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The formation of surface alloys is a growing research field that, in terms of the surface structure of multicomponent systems, defines the frontier both for experimental and theoretical techniques. Because of the impact that the formation of surface alloys has on surface properties, researchers need reliable methods to predict new surface alloys and to help interpret unknown structures. The structure of surface alloys and when, and even if, they form are largely unpredictable from the known properties of the participating elements. No unified theory or model to date can infer surface alloy structures from the constituents properties or their bulk alloy characteristics. In spite of these severe limitations, a growing catalogue of such systems has been developed during the last decade, and only recently are global theories being advanced to fully understand the phenomenon. None of the methods used in other areas of surface science can properly model even the already known cases. Aware of these limitations, the Computational Materials Group at the NASA Glenn Research Center at Lewis Field has developed a useful, computationally economical, and physically sound methodology to enable the systematic study of surface alloy formation in metals. This tool has been tested successfully on several known systems for which hard experimental evidence exists and has been used to predict ternary surface alloy formation (results to be published: Garces, J.E.; Bozzolo, G.; and Mosca, H.: Atomistic Modeling of Pd/Cu(100) Surface Alloy Formation. Surf. Sci., 2000 (in press); Mosca, H.; Garces J.E.; and Bozzolo, G.: Surface Ternary Alloys of (Cu,Au)/Ni(110). (Accepted for publication in Surf. Sci., 2000.); and Garces, J.E.; Bozzolo, G.; Mosca, H.; and Abel, P.: A New Approach for Atomistic Modeling of Pd/Cu(110) Surface Alloy Formation. (Submitted to Appl. Surf. Sci.)). Ternary alloy formation is a field yet to be fully explored experimentally. The computational tool, which is based on the BFS (Bozzolo, Ferrante, and Smith) method for the calculation of the energetics, consists of a small number of simple PCbased computer codes that deal with the different aspects of surface alloy formation. Two analysis modes are available within this package. The first mode provides an atom-by-atom description of real and virtual stages 1. during the process of surface alloying, based on the construction of catalogues of configurations where each configuration describes one possible atomic distribution. BFS analysis of this catalogue provides information on accessible states, possible ordering

patterns, and details of island formation or film growth. More importantly, it provides insight into the evolution of the system. Software developed by the Computational Materials Group allows for the study of an arbitrary number of elements forming surface alloys, including an arbitrary number of surface atomic layers. The second mode involves large-scale temperature-dependent computer 2. simulations that use the BFS method for the energetics and provide information on the dynamic processes during surface alloying. These simulations require the implementation of Monte-Carlo-based codes with high efficiency within current workstation environments. This methodology capitalizes on the advantages of the BFS method: there are no restrictions on the number or type of elements or on the type of crystallographic structure considered. This removes any restrictions in the definition of the configuration catalogues used in the analytical calculations, thus allowing for the study of arbitrary ordering patterns, ultimately leading to the actual surface alloy structure. Moreover, the Monte Carlo numerical technique used for the large-scale simulations allows for a detailed visualization of the simulated process, the main advantage of this type of analysis being the ability to understand the underlying features that drive these processes. Because of the simplicity of the BFS method for e energetics used in these calculations, a detailed atom-by-atom analysis can be performed at any point in the simulation, providing necessary insight on the details of the process. The main objective of this research program is to develop a tool to guide experimenters in understanding and interpreting often unexpected results in alloy formation experiments. By reducing the computational effort without losing physical accuracy, we expect that powerful simulation tools will be developed in the immediate future, which will allow material scientists to easily visualize and analyze processes at a level not achievable experimentally.

Author

Alloys; Mathematical Models; Atoms; Metal Surfaces

20050192338 NASA Glenn Research Center, Cleveland, OH, USA

Solar Absorptance of Cermet Coatings Evaluated

Jaworske, Donald A.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Cermet coatings, molecular mixtures of metal and ceramic, are being considered for the heat inlet surface of solar Stirling convertors. In this application, the key role of the cermet coating is to absorb as much of the incident solar energy as possible. To achieve this objective, the cermet coating has a high solar absorptance value. Cermet coatings are manufactured utilizing sputter deposition, and many different metal and ceramic combinations can be created. The ability to mix metal and ceramic at the atomic level offers the opportunity to tailor the composition, and hence, the optical properties of these coatings. The NASA Glenn Research Center has prepared and characterized a wide variety of cermet coatings utilizing different metals deposited in an aluminum oxide ceramic matrix. In addition, the atomic oxygen durability of these coatings has been evaluated.

Author

Cermets; Protective Coatings; Solar Energy Absorbers; Absorptance; Durability

20050192384 NASA Glenn Research Center, Cleveland, OH, USA

Thermoelastic Stress Analysis: An NDE Tool for the Residual Stress Assessment of Metallic Alloys

Gyekenyesi, Andrew L.; Baaklini, George Y.; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

During manufacturing, certain propulsion components that will be used in a cyclic fatigue environment are fabricated to contain compressive residual stresses on their surfaces because these stresses inhibit the nucleation of cracks. Overloads and elevated temperature excursions cause the induced residual stresses to dissipate while the component is still in service, lowering its resistance to crack initiation. Research at the NASA Glenn Research Center at Lewis Field has focused on employing the Thermoelastic Stress Analysis technique (TSA, also recognized as SPATE: Stress Pattern Analysis by Thermal Emission) as a tool for monitoring the residual stress state of propulsion components. TSA is based on the fact that materials experience small temperature changes when they are compressed or expanded. When a structure is cyclically loaded (i.e., cyclically compressed and expanded), the resulting surface-temperature profile correlates to the stress state of the structure s surface. The surface-temperature variations resulting from a cyclic load are measured with an infrared camera. Traditionally, the temperature amplitude of a TSA signal has been theoretically defined to be linearly dependent on the cyclic stress amplitude. As a result, the temperature amplitude resulting from an applied cyclic stress was assumed to be independent of the cyclic mean stress.

Author

Thermal Emission; Cyclic Loads; Residual Stress; Stress Analysis; Surface Temperature; Temperature Profiles; Thermoelasticity

20050192387 NASA Glenn Research Center, Cleveland, OH, USA

Benchmark Testing of the Largest Titanium Aluminide Sheet Subelement Conducted

Bartolotta, Paul A.; Krause, David L.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

To evaluate wrought titanium aluminide (gamma TiAl) as a viable candidate material for the High-Speed Civil Transport (HSCT) exhaust nozzle, an international team led by the NASA Glenn Research Center at Lewis Field successfully fabricated and tested the largest gamma TiAl sheet structure ever manufactured. The gamma TiAl sheet structure, a 56-percent subscale divergent flap subelement, was fabricated for benchmark testing in three-point bending. Overall, the subelement was 84-cm (33-in.) long by 13-cm (5-in.) wide by 8-cm (3-in.) deep. Incorporated into the subelement were features that might be used in the fabrication of a full-scale divergent flap. These features include the use of: (1) gamma TiAl shear clips to join together sections of corrugations, (2) multiple gamma TiAl face sheets, (3) double hot-formed gamma TiAl corrugations, and (4) brazed joints. The structural integrity of the gamma TiAl sheet subelement was evaluated by conducting a room-temperature three-point static bend test.

Author

Titanium Aluminides; Metal Sheets; Wrought Alloys; Bend Tests; Corrugated Plates; Aircraft Construction Materials

20050192388 NASA Glenn Research Center, Cleveland, OH, USA

Titanium Aluminide Technologies Successfully Transferred From HSR Program to RLV VentureStar Program

Bartolotta, Paul A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Through a cost-share contract, BFGoodrich Aerostructures group successfully fabricated three titanium aluminide (gamma TiAl) truss core structures using technologies pioneered in the High-Speed Research (HSR) program at the NASA Glenn Research Center at Lewis Field. The truss core subelement is approximately 60-cm (24-in.) long by 14-cm (5.5-in.) wide by 6-cm (2.5-in.) deep. To fabricate this subelement, BFGoodrich first obtained gamma TiAl sheets from Plansee (Austria) which produced the sheets using techniques developed collaboratively by Glenn, Pratt & Whitney, and Plansee. This new gamma TiAl production technology has significantly lowered the cost of gamma TiAl sheet (approx. 75-percent decrease) and has made the production of larger gamma TiAl sheets possible (approx. 60-percent increase).

Author (revised)

Titanium Aluminides; Aerospace Technology Transfer; Metal Sheets; Trusses

20050192393 NASA Glenn Research Center, Cleveland, OH, USA

Damage Resistance of Titanium Aluminide Evaluated

Lerch, Bradley A.; Draper, Susan L.; Baaklini, George Y.; Pereira, J. Michael; Austin, Curt; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As part of the aviation safety goal to reduce the aircraft accident rate, NASA has undertaken studies to develop durable engine component materials. One of these materials, g-TiAl, has superior high-temperature material properties. Its low density provides improved specific strength and creep resistance in comparison to currently used titanium alloys. However, this intermetallic is inherently brittle, and long life durability is a potential problem. Of particular concern is the material s sensitivity to defects, which may form during the manufacturing process or in service. To determine the sensitivity of TiAl to defects, a team consisting of GE Aircraft Engines, Precision Cast Parts, and NASA was formed. The work at the NASA Glenn Research Center at Lewis Field has concentrated on the fatigue response to specimens containing defects. The overall objective of this work is to determine the influence of defects on the high cycle fatigue life of TiAl-simulated low-pressure turbine blades. Two types of defects have been introduced into the specimens: cracking from impact damage and casting porosity. For both types of defects, the cast-to-size fatigue specimens were fatigue tested at 650 C and 100 Hz until failure.

Author

Titanium Aluminides; Damage; Fatigue Life; Defects; Fatigue Tests

20050192428 NASA Glenn Research Center, Cleveland, OH, USA

Sandwich Panels Evaluated With Ultrasonic Spectroscopy

Cosgriff, Laura M.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Enhanced, lightweight material systems, such as 17-4PH stainless steel sandwich panels are being developed for use as fan blades and fan containment systems for next-generation engines. The bond strength between the core and face sheets is critical in maintaining the structural integrity of the sandwich structure. To improve the inspection and production of these

systems, researchers at the NASA Glenn Research Center are using nondestructive evaluation (NDE) techniques, such as ultrasonic spectroscopy, to evaluate the brazing quality between the face plates and the metallic foam core. The capabilities and limitations of a swept-frequency approach to ultrasonic spectroscopy were evaluated with respect to these sandwich structures. This report discusses results from three regions of a sandwich panel representing different levels of brazing quality between the outer face plates and a metallic foam core. Each region was investigated with ultrasonic spectroscopy. Then, on the basis of the NDE results, three shear specimens sectioned from the sandwich panel to contain each of these regions were mechanically tested.
Derived from text
Metal Foams; Sandwich Structures; Stainless Steels; Structural Failure

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*.

20050187009 NASA Lewis Research Center, Cleveland, OH, USA
New Vapor/Mist Phase Lubricant Formulated
Morales, Wilfredo; Handschuh, Robert F.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

To meet the increased thermal stresses of future advanced aircraft engines, new lubricants will have to be developed to replace the currently used ester-based liquid lubricants. If a suitable conventional replacement cannot be found, a different lubrication method will have to be used. The conventional method circulates bulk lubricant (stored in a sump) through a lubricating system containing cooling and filtering elements. Solid lubricants have been studied as a replacement for bulk liquid lubricants, and have been found to provide reasonable lubrication for lightly loaded systems. Solid lubricants, however, have proved inadequate for highly loaded, high-speed applications. Vapor/mist phase lubrication (VMPL), on the other hand, may be a viable alternative. VMPL has been used successfully to lubricate high-temperature bearings or gears. It can be used as an emergency backup system or as the primary source of lubrication. With VMPL, minimal weight is added to the system and minimal debris is formed. It works over a wide temperature range.
Author
Vapor Phase Lubrication; Lubricants; Mist; High Temperature Lubricants

20050187056 Florida Univ., Gainesville, FL, USA
Atomic Scale Chemical and Structural Characterization of Ceramic Oxide Heterostructure Interfaces
Singh, R.; January 2005; 12 pp.; In English
Report No.(s): DE2005-836600; No Copyright; Avail: Department of Energy Information Bridge

The research plan was divided into three tasks: (1) growth of oxide heterostructures for interface engineering using standard thin film deposition techniques, (2) atomic level characterization of oxide heterostructure using such techniques as STEM-2 combined with AFM/STM and conventional high-resolution microscopy (HRTEM), and (3) property measurements of aspects important to oxide heterostructures using standard characterization methods, including dielectric properties and dynamic cathodoluminescence measurements. Each of these topics were further classified on the basis of type of oxide heterostructure. Type I oxide heterostructures consisted of active dielectric layers, including the materials Ba(sub x)Sr(sub 1-x)TiO(sub 3) (BST), Y(sub 2)O(sub 3) and ZrO(sub 2). Type II heterostructures consisted of ferroelectric active layers such as lanthanum manganate and Type III heterostructures consist of phosphor oxide active layers such as Eu-doped Y(sub 2)O(sub 3).
NTIS
Atoms; Cathodoluminescence; Ceramics; Oxides

20050187095 NASA Lewis Research Center, Cleveland, OH, USA
Thermal Control Replacement Materials Evaluated for Durability and Selected for the Hubble Space Telescope
deGroh, Kim K.; Banks, Bruce A.; Hansen, Patricia A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

During the Hubble Space Telescope (HST) second servicing mission, astronauts noticed that the outer layer of the multilayer insulation (MLI) was cracked in many locations around the telescope. The insulation s outer layer is composed of

5-mil (0.127 mm) Teflon FEP (DuPont; fluorinated ethylene propylene) with vapor-deposited aluminum (VDA) on the backside. The MLI blankets, which are used on over 80 percent of the external surface of the telescope, provide passive thermal control for equipment. Two large cracks were observed on the light shield directly above the high gain antenna. The upper light shield crack propagated from a cut placed in the blanket during installation around a handrail standoff. Two cracks propagated almost normal to each other, with the outer layer curling tightly as the cracks propagated. A second much larger vertical crack had started to curl and lift away from the telescope, as seen in the figure. MLI on the equipment bays was cracked extensively also, and in some areas it had pulled away from the bay. Continued degradation of the equipment bay insulation would potentially cause limited observations because of housekeeping boxes; for example, the data interface unit could overheat during some portions of the year, in certain sun angles.
Derived from text
Vapor Deposition; Aluminum; Multilayer Insulation; Durability

20050187102 Delaware Univ., Newark, DE, USA
Real Time Spectroscopic Studies of Structure and Orientation Development in Polymers: Potential Techniques for Intelligent Manufacturing (September 15, 1999-September 14, 2002)
Rabolt, J. F.; Chase, D. B.; Jul. 2003; 16 pp.; In English
Report No.(s): DE2005-820039; No Copyright; Avail: Department of Energy Information Bridge

The use of polymeric materials is extremely widespread in our lives today. The value of these materials is directly related to various macroscopic properties. High elasticity, toughness, and strength may all be ultimately important to the end user. A large number of analytical tests can be used to measure these macroscopic properties after the material has been processed. However, it is important to remember that these macroscopic properties ultimately derive from molecular level effects and hence, are already set when processing is complete. Polymers can be extruded into films, spun into fibers, and molded into parts with differing properties, but the understanding of how these properties can be affected by the processing step is unclear. An understanding of the cause and effect.
NTIS
Manufacturing; Mechanical Properties; Real Time Operation; Spectroscopy

20050187108 Blasch Precision Ceramics, Inc., Albany, NY, USA
Development of a Monolithic Ceramic Cross-Flow Filter, Part 2
January 2004; 14 pp.; In English
Report No.(s): DE2004-834390; No Copyright; Avail: Department of Energy Information Bridge

Ceramic cross-flow filters were designed to provide high temperature, high pressure removal of particulates from hot gas streams in coal fueled power systems, with the benefit of high surface area per unit volume. An important need has been identified as a one-piece monolithic ceramic crossflow filter, rather than the most recent segmented filter that has been known to delaminate/separate in service. Current ceramic technology has proved incapable of forming a complex one-piece shape such as this, with an acceptable permeable, porous ceramic material. Blasch's unique and proprietary injection mold ceramic forming process has commercially produced complex shapes of this nature for many years, but of a non-permeable ceramic. In the earlier SBIR Phase I work, permeable, porous ceramic compositions were developed, targeted to meet the filtration and other requirements of crossflow filters. In this SBIR Phase II effort, the ceramic composition data and lab scale process techniques established in Phase I are being used as the basis for prototype production of full-size monolithic ceramic cross-flow filters. After production, these prototypes will be subjected to filtration testing, followed by post-test characterization.
NTIS
Ceramics; Cross Flow; Filtration

20050188472 NASA Glenn Research Center, Cleveland, OH, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA
Teflon FEP Analyzed After Retrieval From the Hubble Space Telescope
Dever, Joyce A.; deGroh, Kim K.; Townsend, Jacqueline A.; Hansen, Patricia A.; Banks, Bruce A.; Wang, Len; He, Charles; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

During the Hubble Space Telescope (HST) Second Servicing Mission, 6.8 years after the telescope was deployed in low Earth orbit, degradation of unsupported Teflon FEP (DuPont; fluorinated ethylene propylene), used as the outer layer of the multilayer insulation (MLI) blankets, was evident as large cracks on the telescope light shield. A sample of the degraded outer

layer (see the photograph) was retrieved during the second servicing mission and returned to Earth for ground testing and evaluation. Also retrieved was a Teflon FEP radiator surface from a cryogen vent cover that was exposed to the space environment on the aft bulkhead of the HST. NASA Goddard Space Flight Center directed the efforts of the Hubble Space Telescope MLI Failure Review Board, whose goals included determining the FEP degradation mechanisms. As part of the investigations into the degradation mechanisms, specimens retrieved from the first and second HST servicing missions, 3.6 and 6.8 years after launch, respectively, were characterized through exhaustive mechanical, optical, and chemical testing. Testing led by Goddard included scanning electron microscopy, optical microscopy, tensile testing, solar absorptance measurements, time-of-flight secondary ion mass spectroscopy (TOF-SIMS), Fourier transform infrared microscopy (m-FTIR), attenuated total reflectance infrared microscopy (ATR/FTIR), and x-ray diffraction (XRD). The NASA Lewis Research Center contributed significantly to the analysis of the retrieved HST materials by leading efforts and providing results of bend testing, surface microhardness measurements, x-ray photoelectron spectroscopy, solid-state nuclear magnetic resonance spectroscopy, and density measurements. Other testing was conducted by Nano Instruments, Inc., and the University of Akron.
Derived from text
Hubble Space Telescope; Teflon (Trademark); Degradation; Multilayer Insulation; Ethylene; Propylene

20050188499 NASA Lewis Research Center, Cleveland, OH, USA
Nondestructive Strain Measurement System Used to Determine Surface Strain on Fibers
Tuma, Margaret L.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Small-diameter structural fibers are being considered as reinforcements for high temperature ceramic matrix composite materials, and thus they require characterization. At the NASA Lewis Research Center, a nondestructive optical technique was used to determine surface strain on a structural fiber, in real time, as it was pulled in a tensile test machine. With this technique, interference or speckle patterns from the laser illuminated fiber test specimen are recorded. As the fiber is pulled, its speckle pattern shifts in proportion to the strain, translation, and rotation components of the sample deformation. Shifting speckle patterns are detected in real time by two linear charge-coupled discharge (CCD) camera arrays, and the images are processed by a hardware correlator. Surface strain is selectively detected on fibers with diameters on the order of 100 mm and can be resolved to 19 microstrain. This system was designed to be robust and compact and generally does not require surface preparation of the structural fibers. For strain detection, two laser beams are positioned incident on the structural fiber being tested, as shown in the photograph, where the test specimen is mounted in a tensile test machine via two coupons. As the fiber is pulled, the speckle pattern produced from each laser beam is detected by one of two CCD arrays located inside the tube on the right side of the photograph.
Author
Nondestructive Tests; Strain Measurement; Fiber Strength

20050188539 NASA Lewis Research Center, Cleveland, OH, USA
Viscoplastic Constitutive Theory Demonstrated for Monolithic Ceramic Materials
Janosik, Lesley A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Development of accurate three-dimensional (multiaxial) inelastic stress-strain models is critical in utilizing advanced ceramics for challenging 21st century high-temperature structural applications. The current state of the art uses elastic stress fields as a basis for both subcritical crack growth and creep life prediction efforts aimed at predicting the time dependent reliability response of ceramic components subjected to elevated service temperatures. However, to successfully design components that will meet tomorrow's challenging requirements, design engineers must recognize that elastic predictions are inaccurate for these materials when subjected to high-temperature service conditions such as those encountered in advanced heat engine components. Analytical life prediction methodologies developed for advanced ceramics and other brittle materials must employ accurate constitutive models that capture the inelastic response exhibited by these materials at elevated service temperatures. A constitutive model recently developed at the NASA Lewis Research Center helps address this issue by accounting for the time-dependent (inelastic) material deformation phenomena (e.g., creep, rate sensitivity, and stress relaxation) exhibited by monolithic ceramics exposed to high-temperature service conditions. In addition, the proposed formulation is based on a threshold function that is sensitive to hydrostatic stress and allows different behavior in tension and compression, reflecting experimental observations obtained for these material systems.
Derived from text
Ceramics; Viscoplasticity; Brittle Materials

20050189184 Air Force Research Lab., Tyndall AFB, FL USA

Full Scale Testing of Polymer Reinforced Blast Resistant Windows

Trawinski, Elizabeth; Fisher, Jeff W.; Dinan, Robert J.; Dec. 2004; 69 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F08637-03-C-6006; Proj-4918

Report No.(s): AD-A433925; AFRL-ML-TY-TP-2005-4508; No Copyright; Avail: Defense Technical Information Center (DTIC)

Summary of the state of the art in research and design of protective glazing and recent full-scale testing efforts of the Air Force Research Laboratory (AFRL) on blast resistant windows that use advanced materials. Failure mechanisms observed from recent explosive tests are presented, along with analytical models that are being developed to predict the resistance provided by the polymer reinforcement. Challenges include optimizing mechanical properties of reinforcement, design thickness and lay-up of the polymer and glass layers, and designing optimum mechanisms for transferring load to host structure. The needs and direction of future blast resistant window research are discussed.

DTIC

Glass; Polymers

20050189204 Brookhaven National Lab., Upton, NY USA

Citric Acid as a Set Retarder for Calcium Aluminate Phosphate Cements

Sugama, T.; Brothers, L. E.; Jan. 2005; 38 pp.; In English

Report No.(s): DE2005-15011163; BNL-736000-2005; No Copyright; Avail: Department of Energy Information Bridge

Citric acid added as set retarder significantly contributed to enhancing the setting temperature and to extending the thickening time of a calcium aluminate phosphate (CaP) geothermal cement slurry consisting of calcium aluminate cement (CAC) as the base reactant and sodium polyphosphate (NaP) solution as the acid reactant. The set-retarding activity of citric acid was due to the uptake of Ca(sup 2+) ions from the CAC by carboxylic acid groups within the citric acid. This uptake led to the precipitation of a Ca-complexed carboxylate compound as a set-retarding barrier layer on the CAC grains' surfaces. However, this barrier layer was vulnerable to disintegration by the attack of free Ca(sup 2+) ions from CAC, and also to degradation at elevated temperature, thereby promoting the generation of exothermic energy from acid-base reactions between the CAC and NaP after the barrier was broken. The exothermic reaction energy that was promoted in this way minimized the loss in strength of the citric acid-retarded cement. The phase composition assembled in both retarded and non-retarded cements after autoclaving at 180 degrees C encompassed three reaction products, hydroxyapatite (HOAp), hydrogrossular and boehmite, which are responsible for strengthening the autoclaved cement.

NTIS

Aluminates; Calcium Phosphates; Cements; Citric Acid; Wells

20050189234 Selee Corp., Hendersonville, NC, USA

Small Business Innovation Research Program Phase II-FY 1997-1. Project Summary

January 2005; 76 pp.; In English

Report No.(s): DE2005-824154; No Copyright; Avail: Department of Energy Information Bridge

Composite CeTZP/A1(sub 2)O(sub 3) (CeZTA) foams were developed and tested to determine their suitability as particulate filters in hot gaseous conditions generated by coal combustion in electric power plants. Exposure to these extreme corrosive conditions did not cause significant degradation in strength. Superior properties of these foams suggests they could be used for a variety of applications in environment, energy and chemical fields.

NTIS

Ceramics; Commerce; Composite Materials

20050189236 Lehigh Univ., Bethlehem, PA, USA

Stability of Bulk Metallic Glass Structure

Jain, H.; Williams, D. B.; Jun. 2003; 124 pp.; In English

Report No.(s): DE2005-825897; No Copyright; Avail: Department of Energy Information Bridge

The fundamental origins of the stability of the (Pd-Ni)(sub 80)P(sub 20) bulk metallic glasses (BMGs), a prototype for a whole class of BMG formers, were explored. While much of the properties of their BMGs have been characterized, their glass-stability have not been explained in terms of the atomic and electronic structure. The local structure around all three constituent atoms was obtained, in a complementary way, using extended X-ray absorption fine structure (EXAFS), to probe the nearest neighbor environment of the metals, and extended energy loss fine structure (EXELFS), to investigate the

environment around P. The occupied electronic structure was investigated using X-ray photoelectron spectroscopy (XPS). The (Pd-Ni)(sub 80)P(sub 20) BMGs receive their stability from cumulative, and interrelated, effects of both atomic and electronic origin. The stability of the (Pd-Ni)(sub 80)P(sub 20) BMGs can be explained in terms of the stability of Pd(sub 60)Ni(sub 20)P(sub 20) and Pd(sub 30)Ni(sub 50)P(sub 20), glasses at the end of BMG formation. The atomic structure in these alloys is very similar to those of the binary phosphide crystals near x=0 and x=80, which are trigonal prisms of Pd or Ni atoms surrounding P atoms.
NTIS
Metallic Glasses; Stability; X Ray Absorption; Crystals; Atomic Structure

20050189243 Department of Energy, Washington, DC USA
Application of the Evacuated Canister System for Removing Residual Molten Glass From the West Valley Demonstration Project High-Level Waste Melter
May, J. J.; January 2003; 14 pp.; In English
Report No.(s): DE2005-825763; No Copyright; Avail: Department of Energy Information Bridge
The principal mission of the West Valley Demonstration Project (WVDP) is to meet a series of objectives defined in the West Valley Demonstration Project Act (Public Law 96-368). Chief among these is the objective to solidify liquid high-level waste (HLW) at the WVDP site into a form suitable for disposal in a federal geologic repository. In 1982, the Secretary of Energy formally selected vitrification as the technology to be used to solidify HLW at the WVDP. One of the first steps in meeting the HLW solidification objective involved designing, constructing and operating the Vitrification (Vit) Facility, the WVDP facility that houses the systems and subsystems used to process HLW into stainless steel canisters of borosilicate waste-glass that satisfy waste acceptance criteria (WAC) for disposal in a federal geologic repository. HLW processing and canister production began in 1996. The final step in meeting the HLW solidification objective involved ending Vit system operations and shutting down the Vit Facility. This was accomplished by conducting a discrete series of activities to remove as much residual material as practical from the primary process vessels, components, and associated piping used in HLW canister production before declaring a formal end to Vit system operations.
NTIS
Cans; Glass; Valleys; Liquid Wastes; Solidification

20050189245 Alfred Univ., NY, USA
Structure, Stoichiometry and Stability in Megnetoplumbie and beta-Alumina Structured Type Ceramics
Cormack, A. N.; Mar. 01, 2004; 20 pp.; In English
Report No.(s): DE2005-825870; No Copyright; Avail: Department of Energy Information Bridge
Work has been completed on the atomistic simulation of hexa-aluminate ceramics with the magnetoplumbite and beta-alumina type structures. In this report, three aspects of the work are highlighted. One is the simulation of surface structures. The second concerns details of the interstitially mechanisms observed in molecular dynamics simulations. The novel result here is the observation that the lattice ion always leaves its Beevers-Ross site before the interstitial begins to move towards the lattice site. It is also found that, as expected, the interstitial mechanism is the most common mechanism in the heavily disordered nonstoichiometric structure, as well as in the stoichiometric material. Finally, the disposition of trivalent europium in the phosphor material BAM has been elucidated.
NTIS
Aluminates; Aluminum Oxides; Ceramics; Stability; Stoichiometry

20050189250 Kentucky Univ., Lexington, KY USA
Inspection and Evaluation of a Bridge Deck Partially Reinforced with GFRP Rebars
Harik, I. E.; Alagusundaramoorthy, P.; Gupta, V.; Hill, C. D.; Chiaw, C. C.; Aug. 2004; 110 pp.; In English
Report No.(s): PB2005-107425; KTC-04-21/FRPDECK-1-97-1F; No Copyright; Avail: CASI; A06, Hardcopy
The corrosion of steel can be a significant problem in bridge decks in which the reinforcing and prestressing steel are accessible to deicing salts and combinations of moisture, temperature and chlorides through cracks, leading to concrete deterioration and loss of serviceability. Fiber Reinforced Polymer (FRP) rebars have emerged as one alternative to steel reinforcement in corrosive environments. The objective of this study is to evaluate the cracks formed on a bridge deck that is partially reinforced with glass fiber reinforced polymer (GFRP) rebars. The bridge constructed in 1997 is in Bourbon County, KY, on US460 over the Rogers' Creek. It's deck is partially reinforced with GFRP rebars in place of epoxy coated steel rebars. The bridge has been monitored for cracks over a period of two years from June 1998 to July 2000. The maximum

measured crack width of 0.013 in (0.3 mm) in the GFRP reinforced section meets the maximum allowed by ACI (Section 10.6) and AASHTO (Section 8.16.8.4) specifications in steel reinforced structures for exterior exposure.
NTIS
Fiber Composites; Glass Fiber Reinforced Plastics; Inspection

20050192042 Georgia Inst. of Tech., Atlanta, GA, USA
Search for the Microscopic Origin of Defects and Shear Localization in Metallic Glasses
Nov. 10, 2001; 22 pp.; In English
Report No.(s): DE2005-821158; No Copyright; Avail: Department of Energy Information Bridge

This proposed research addresses one of the long outstanding fundamental problems in materials science, the mechanisms of deformation in amorphous metals. Due to the lack of long-range translational order, details of structural defects and their behaviors in metallic glasses have not been accessible in experiments. In addition, the small dimensions of the amorphous alloys made early by rapid quenching impose severe limit on many standard mechanical and microscopy testing. As a result, the microscopic mechanism of deformation in the amorphous materials has not been established. The recent success in synthesis of bulk metallic glass overcomes the difficulty in standard testing; but the barrier for understanding the defect process and microscopic mechanisms of deformation still remains. Amorphous metals deform in a unique way by shear banding. As a result, there is no work hardening, little macroscopic plasticity, and catastrophic failure. To retain and improve the inherent high strength, large elastic strain, and high toughness in amorphous metals, a variety of synthesis activities are currently underway including making metallic glass matrix composites. These new explorations call for a quantitative understanding of deformation mechanisms in both the monolithic metallic glasses as well as their composites.
NTIS
Defects; Metallic Glasses; Position (Location)

20050192047 Idaho National Engineering Lab., Idaho Falls, ID, USA
FeAl and Mo-Si-B Intermetallic Coatings Prepared by Thermal Spraying
Totemeier, T. C.; Wright, R. N.; Swank, W. D.; January 2005; 12 pp.; In English
Report No.(s): DE2005-835689; No Copyright; Avail: Department of Energy Information Bridge

FeAl and Mo-Si-B intermetallic coatings for elevated temperature environmental resistance were prepared using high-velocity oxy-fuel (HVOF) and air plasma spray (APS) techniques. For both coating types, the effect of coating parameters (spray particle velocity and temperature) on the microstructure and physical properties of the coatings was assessed. Fe-24Al (wt.%) coatings were prepared using HVOF thermal spraying at spray particle velocities varying from 540 m/s to 700 m/s. Mo-13.4Si-2.6B coatings were prepared using APS at particle velocities of 180 and 350 m/s. Residual stresses in the HVOF FeAl coatings were compressive, while stresses in the APS Mo-Si-B coatings were tensile. In both cases, residual stresses became more compressive with increasing spray particle velocity due to increased peening imparted by the spray particles. The hardness and elastic moduli of FeAl coatings also increased with increasing particle velocity, again due to an increased peening effect. For Mo-Si-B coatings, plasma spraying at 180 m/s resulted in significant oxidation of the spray particles and conversion of the T1 phase into amorphous silica and (alpha)-Mo. The T1 phase was retained after spraying at 350 m/s.
NTIS
Intermetallics; Sprayers; Spraying; Coatings

20050192102 NASA Lewis Research Center, Cleveland, OH, USA
'Ultra'-Fast Fracture Strength of Advanced Structural Ceramic Materials Studied at Elevated Temperatures
Choi, Sung R.; Gyekenyesi, John P.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The accurate determination of inert strength is important in reliable life prediction of structural ceramic components. At ambient temperature, the inert strength of a brittle material is typically regarded as free of the effects of slow crack growth due to stress corrosion. Therefore, the inert strength can be determined either by eliminating active species, especially moisture, with an appropriate inert medium, or by using a very high test rate. However, at elevated temperatures, the concept or definition of the inert strength of brittle ceramic materials is not clear, since temperature itself is a degrading environment, resulting in strength degradation through slow crack growth and/or creep. Since the mechanism to control strength is rate-dependent viscous flow, the only conceivable way to determine the inert strength at elevated temperatures is to utilize a very fast test rate that either minimizes the time for or eliminates slow crack growth. Few experimental studies have measured

the elevated-temperature, inert (or 'ultra'-fast fracture) strength of advanced ceramics. At the NASA Lewis Research Center, an experimental study was initiated to better understand the 'ultra'-fast fracture strength behavior of advanced ceramics at elevated temperatures. Fourteen advanced ceramics - one alumina, eleven silicon nitrides, and two silicon carbides - have been tested using constant stress-rate (dynamic fatigue) testing in flexure with a series of stress rates including the 'ultra'-fast stress rate of 33 000 MPa/sec with digitally controlled test frames. The results for these 14 advanced ceramics indicate that, notwithstanding possible changes in flaw populations as well as flaw configurations because of elevated temperatures, the strength at 33 000 MPa/sec approached the room-temperature strength or reached a higher value than that determined at the conventional test rate of 30 MPa/sec. On the basis of the experimental data, it can be stated that the elevated-temperature, inert strength of an advanced ceramic material can be defined as the strength where no slow crack growth takes place at the temperature.
Derived from text
High Temperature Tests; Ceramics; Fracture Strength; Dynamic Tests; Life (Durability); Fatigue Tests

20050192182 NASA Glenn Research Center, Cleveland, OH, USA
Processing Techniques Developed to Fabricate Lanthanum Titanate Piezoceramic Material for High-Temperature Smart Structures
Goldsby, Jon C.; Farmer, Serene C.; Sayir, Ali; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Piezoelectric ceramic materials are potential candidates for use as actuators and sensors in intelligent gas turbine engines. For piezoceramics to be applied in gas turbine engines, they will have to be able to function in temperatures ranging from 1000 to 2500 F. However, the maximum use temperature for state-of-the-art piezoceramic materials is on the order of 300 to 400 F. Research activities have been initiated to develop high-temperature piezoceramic materials for gas turbine engine applications. Lanthanum titanate has been shown to have high-temperature piezoelectric properties with Curie temperatures of T(sub c) = 1500 C and use temperatures greater than 1000 C. However, the fabrication of lanthanum titanate poses serious challenges because of the very high sintering temperatures required for densification. Two different techniques have been developed at the NASA Glenn Research Center to fabricate dense lanthanum titanate piezoceramic material. In one approach, lower sintering temperatures were achieved by adding yttrium oxide to commercially available lanthanum titanate powder. Addition of only 0.1 mol% yttrium oxide lowered the sintering temperature by as much as 300 C, to just 1100 C, and dense lanthanum titanate was produced by pressure-assisted sintering. The second approach utilized the same commercially available powders but used an innovative sintering approach called differential sintering, which did not require any additive.
Derived from text
Piezoelectric Ceramics; Smart Materials; Lanthanum; Titanium

20050192183 NASA Glenn Research Center, Cleveland, OH, USA
Boron Nitride Nanotubes Synthesized by Pressurized Reactive Milling Process
Hurst, Janet B.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Nanotubes, because of their very high strength, are attractive as reinforcement materials for ceramic matrix composites (CMCs). Recently there has been considerable interest in developing and applying carbon nanotubes for both electronic and structural applications. Although carbon nanotubes can be used to reinforce composites, they oxidize at high temperatures and, therefore, may not be suitable for ceramic composites. Boron nitride, because it has a higher oxidation resistance than carbon, could be a potential reinforcement material for ceramic composites. Although boron nitride nanotubes (BNnT) are known to be structurally similar to carbon nanotubes, they have not undergone the same extensive scrutiny that carbon nanotubes have experienced in recent years. This has been due to the difficulty in synthesizing this material rather than lack of interest in the material. We expect that BNnTs will maintain the high strength of carbon nanotubes while offering superior performance for the high-temperature and/or corrosive applications of interest to NASA. At the NASA Glenn Research of preparing BN-nTs were investigated and compared. These include the arc jet process, the reactive milling process, and chemical vapor deposition. The most successful was a pressurized reactive milling process that synthesizes BN-nTs of reasonable quantities.
Author
Boron Nitrides; Nanotubes; Nanofabrication

20050192252 NASA Glenn Research Center, Cleveland, OH, USA
Development of DMBZ-15 High-Glass-Transition-Temperature Polyimides as PMR-15 Replacements Given R&D 100 Award
Chuang, Kathy; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

PMR-15, a high-temperature polyimide developed in the mid-1970s at the NASA Lewis Research Center,1 offers the combination of low cost, easy processing, and good high-temperature performance and stability. It has been recognized as the leading polymer matrix resin for carbon-fiber-reinforced composites used in aircraft engine components. The state-of-the-art PMR-15 polyimide composite has a glass-transition temperature (Tg) of 348 C (658 F). Since composite materials must be used at temperatures well below their glass-transition temperature, the long-term use temperatures of PMR-15 composites can be no higher than 288 C (550 F). In addition, PMR-15 is made from methylene dianiline (MDA), a known liver toxin. Concerns about the safety of workers exposed to MDA during the fabrication of PMR-15 components and about the environmental impact of PMR-15 waste disposal have led to the industry-wide implementation of special handling procedures to minimize the health risks associated with this material. These procedures have increased manufacturing and maintenance costs significantly and have limited the use of PMR-15 in commercial aircraft engine components.
Derived from text
Polyimides; Composite Materials; Fabrication; Fiber Composites; Glass Transition Temperature

20050192255 NASA Glenn Research Center, Cleveland, OH, USA
Mechanically Strong Aerogels Formed by Templated Growth of Polymer Cross- Linkers on Inorganic Nanoparticles
Leventis, Nicholas; Fabrizio, Eve F.; Johnston, Chris; Meador, Maryann; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In the search for materials with better mechanical, thermal, and electrical properties, it is becoming evident that oftentimes dispersing ceramic nanoparticles in plastics improves performance. Along these lines, chemical bonding (both covalent and noncovalent) between a filler and a polymer improves their compatibility, and thus enhances certain properties of the polymeric matrix above and beyond what is accomplished by simple doping with the filler. When a similarly sized dopant and matrix are used, elementary building blocks may also have certain distinct advantages (e.g., in catalysis). In this context, researchers at the NASA Glenn Research Center reasoned that in the extreme case, where the dopant and the matrix (e.g., a filler and a polymer) are not only sized similarly, but their relative amounts are comparable, the relative roles of the dopant and matrix can be reversed. Then, if the 'filler,' or a certain form thereof, possesses desirable properties of its own, such properties could be magnified by cross-linking with a polymer. We at Glenn have identified silica as such a filler in its lowest-density form, namely the silica aerogel.
Derived from text
Electrical Properties; Mechanical Properties; Thermodynamic Properties; Aerogels; Plastics

20050192275 NASA Lewis Research Center, Cleveland, OH, USA
Diagnostic Techniques Used to Study Chemical-Vapor-Deposited Diamond Films
Miyoshi, Kazuhisa; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The advantages and utility of chemical-vapor-deposited (CVD) diamond as an industrial ceramic can only be realized if the price and quality are right. Until recently, this technology was of interest only to the academic and basic research community. However, interest has grown because of advances made by leading CVD diamond suppliers: 1) Reduction of the cost of CVD polycrystalline diamond deposition below $5/carat ($8/sq cm); 2) Installation of production capacity; 3) Epitaxial growth of CVD single-crystal diamond. Thus, CVD diamond applications and business are an industrial reality. At present, CVD diamond is produced in the form of coatings or wafers. CVD diamond film technology offers a broader technological potential than do natural and high-pressure synthetic diamonds because size, geometry, and eventually cost will not be as limiting. Now that they are cost effective, diamond coatings - with their extreme properties - can be used in a variety of applications. Diamond coatings can improve many of the surface properties of engineering substrate materials, including erosion, corrosion, and wear resistance. Examples of actual and potential applications, from microelectromechanical systems to the wear parts of diamond coatings and related superhard coatings are described. For example, diamond coatings can be used as a chemical and mechanical barrier for the space shuttles check valves, particularly on the guide pins and seat assemblies.
Author
Vapor Deposition; Diamond Films; Nonintrusive Measurement; Nondestructive Tests

20050192336 NASA Glenn Research Center, Cleveland, OH, USA
Effects of Various Wavelength Ranges of Vacuum Ultraviolet Radiation on Teflon FEP Film Investigated
Dever, Joyce A.; McCracken, Cara A.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Teflon Fluorinated Ethylene Propylene (FTP) films (DuPont) have been widely used for spacecraft thermal control and have been observed to become embrittled and cracked upon exposure to the space environment. This degradation has been attributed to a synergistic combination of radiation and thermal effects. A research study was undertaken at the NASA Glenn Research Center to examine the effects of different wavelength ranges of vacuum ultraviolet (VUV) radiation on the degradation of the mechanical properties of FEP. This will contribute to an overall understanding of space radiation effects on Teflon FEP, and will provide information necessary to determine appropriate techniques for using laboratory tests to estimate space VUV degradation. Research was conducted using inhouse facilities at Glenn and was carried out, in part, through a grant with the Cleveland State University. Samples of Teflon FEP film of 50.8 microns thickness were exposed to radiation from a VUV lamp from beneath different cover windows to provide different exposure wavelength ranges: MgF2 (115 to 400 nm), crystalline quartz (140 to 400 nm), and fused silica (FS, 155 to 400 nm). Following exposure, FEP film specimens were tensile tested to determine the ultimate tensile strength and elongation at failure as a function of the exposure duration for each wavelength range. The graphs show the effect of ultraviolet exposure on the mechanical properties of the FEP samples.
Derived from text
Teflon (Trademark); Wavelengths; Film Thickness

20050192337 NASA Glenn Research Center, Cleveland, OH, USA, Applied Science Associates, Inc., Cedar Hill, OH, USA
Resistivity of Carbon-Carbon Composites Halved
Gaier, James R.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Carbon-carbon composites have become the material of choice for applications requiring strength and stiffness at very high temperatures (above 2000 C). These composites comprise carbon or graphite fibers embedded in a carbonized or graphitized matrix. In some applications, such as shielding sensitive electronics in very high temperature environments, the performance of these materials would be improved by lowering their electrical resistivity. One method to lower the resistivity of the composites is to lower the resistivity of the graphite fibers, and a proven method to accomplish that is intercalation. Intercalation is the insertion of guest atoms or molecules into a host lattice. In this study the host fibers were highly graphitic pitch-based graphite fibers, or vapor-grown carbon fibers (VGCF), and the intercalate was bromine. Intercalation compounds of graphite are generally thought of as being only metastable, but it has been shown that the residual bromine graphite fiber intercalation compound is remarkably stable, resisting decomposition even at temperatures at least as high as 1000 C. The focus of this work was to fabricate composite preforms, determine whether the fibers they were made from were still intercalated with bromine after processing, and determine the effect on composite resistivity. It was not expected that the resistivity would be lowered as dramatically as with graphite polymer composites because the matrix itself would be much more conductive, but it was hoped that the gains would be substantial enough to warrant its use in high-performance applications. In a collaborative effort supporting a Space Act Agreement between the NASA Glenn Research Center and Applied Sciences, Inc. (Cedarville, OH), laminar preforms were fabricated with pristine and bromine-intercalated pitch-based fibers (P100 and P100-Br) and VGCF (Pyro I and Pyro I-Br). The green preforms were carbonized at 1000 C and then heat treated to 3000 C. To determine whether the fibers in the samples were still intercalated after composite fabrication, they were subjected to X-ray diffraction. The composites containing intercalated graphite fibers showed much higher background scatter than that of pristine fibers, indicating the presence of bromine in the samples. More importantly, faint features indicative of intercalation were visible in the diffraction pattern, showing that the fibers were still intercalated.
Author
Carbon-Carbon Composites; Electrical Resistivity; High Temperature Environments; X Ray Diffraction

20050192352 NASA Glenn Research Center, Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA
Automated Reflectance Measurement System Designed and Fabricated to Determine the Limits of Atomic Oxygen Treatment of Art Through Contrast Optimization
Sechkar, Edward A.; Stueber, Thomas J.; Rutledge, Sharon K.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Atomic oxygen generated in ground-based research facilities has been used to not only test erosion of candidate spacecraft materials but as a noncontact technique for removing organic deposits from the surfaces of artwork. NASA has patented the use of atomic oxygen to remove carbon-based soot contamination from fire-damaged artwork. The process of cleaning soot-damaged paintings with atomic oxygen requires exposures for variable lengths of time, dependent on the condition of a painting. Care must be exercised while cleaning to prevent the removal of pigment. The cleaning process must be stopped as soon as visual inspection or surface reflectance measurements indicate that cleaning is complete. Both techniques rely on optical comparisons of known bright locations against known dark locations on the artwork being cleaned. Difficulties arise

with these techniques when either a known bright or dark location cannot be determined readily. Furthermore, dark locations will lighten with excessive exposure to atomic oxygen. Therefore, an automated test instrument to quantitatively characterize cleaning progression was designed and developed at the NASA Glenn Research Center at Lewis Field to determine when atomic oxygen cleaning is complete.
Derived from text
Oxygen Atoms; Research Facilities; Reflectance

20050192401 NASA Glenn Research Center, Cleveland, OH, USA
Temperature Correction of Pressure-Sensitive Paints Simplified
Bencic, Timothy J.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Pressure-sensitive paint (PSP) has become a useful tool to augment conventional pressure taps in measuring the surface pressure distribution of aerodynamic components in wind tunnel testing. Although PSP offers the advantage of nonintrusive global mapping of the surface pressure, one prominent drawback to the accuracy of this technique is the inherent temperature sensitivity of PSP's luminescent intensity. Typical aerodynamic surface PSP tests rely on the coated surface to be both spatially and temporally isothermal, along with conventional instrumentation, to yield the highest accuracy pressure mappings. In some tests, however, spatial and temporal thermal gradients are generated by the nature of the test, as in a blowing jet impinging on a surface. In these cases, high accuracy and reliable data cannot be obtained unless the temperature variations on the painted surface are accounted for. A new temperature-correction technique was developed at the NASA Glenn Research Center at Lewis Field to collapse a 'family' of PSP calibration curves to a single curve of intensity ratio versus pressure. This correction allows a streamlined procedure to be followed whether or not temperature information is used in the data reduction of the PSP.
Derived from text
Pressure Sensitive Paints; Paints; Temperature Sensitive Paints

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PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*; and *44 Energy Production and Conversion*.

20050186900 NASA Glenn Research Center, Cleveland, OH, USA
Screen Channel Liquid Acquisition Devices for Cryogenic Propellants
Chato, David J.; Kudlac, Maureen T.; June 2005; 14 pp.; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA
Contract(s)/Grant(s): WBS 22-614-50-04-11
Report No.(s): NASA/TM-2005-213638; AIAA Paper 2002-3983; E-15122; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes an on-going project to study the application screen channel liquid acquisition devices to cryogenic propellant systems. The literature of screen liquid acquisition devices is reviewed for prior cryogenic experience. Test programs and apparatus are presented to study these devices. Preliminary results are shown demonstrating bubble points for 200 x 1400 wires per inch and 325 x 2300 wires per inch Dutch twill screens. The 200 x 1400 screen has a bubble point of 15.8 inches of water in isopropyl alcohol and 6.6 inches of water in liquid nitrogen. The 325 x 2300 screen has a bubble point of 24.5 inches of water in isopropyl alcohol, 10.7 inches of water in liquid nitrogen, and 1.83 inches of water in liquid hydrogen. These values are found to be in good agreement with the results reported in the literature.
Author
Cryogenic Rocket Propellants; Liquid Hydrogen; Liquid Nitrogen; Cryogenics

20050187106 TRW Environmental Services, Las Vegas, NV, USA
Civilian Radioactive Waste Management System Management and Operating Contractor. Environmental Baseline File for National Transportation
Jun. 1999; 56 pp.; In English
Report No.(s): DE2005-762964; No Copyright; Avail: Department of Energy Information Bridge

This Environmental Baseline File summarizes and consolidates information related to the national-level transportation of commercial spent nuclear fuel. Topics addressed include: shipments of commercial spent nuclear fuel based on mostly truck

and mostly rail shipping scenarios; transportation routing for commercial spent nuclear fuel sites and DOE sites; radionuclide inventories for various shipping container capacities; transportation routing; populations along transportation routes; urbanized area population densities; the impacts of historical, reasonably foreseeable, and general transportation; state-level food transfer factors; Federal Guidance Report No. 11 and 12 radionuclide dose conversion factors; and national average atmospheric conditions.
NTIS
Civil Defense; Contractors; Management Systems; Radioactive Wastes; Transportation; Waste Management

20050188516 NASA Lewis Research Center, Cleveland, OH, USA
X-33 Combustion-Wave Ignition System Tested
Liou, Larry C.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Lewis Research Center, in cooperation with Rocketdyne, the Boeing Company, tested a novel rocket engine ignition system, called the combustion-wave ignition system, in its Research Combustion Laboratory. This ignition system greatly simplifies ignition in rocket engines that have a large number of combustors. The particular system tested was designed and fabricated by Rocketdyne for the national experimental spacecraft, X-33, which uses Rocketdyne s aerospike rocket engines. The goal of the tests was to verify the system design and define its operational characteristics. Results will contribute to the eventual successful flight of X-33. Furthermore, the combustion-wave ignition system, after it is better understood and refined on the basis of the test results and, later, flight-proven onboard X-33, could become an important candidate engine ignition system for our Nation s next-generation reusable launch vehicle.
Derived from text
X-33 Reusable Launch Vehicle; Ignition Systems; Flame Propagation

20050189199 NASA Lewis Research Center, Cleveland, OH, USA
Rapid Chill and Fill of a Liquid Hydrogen Tank Demonstrated
Kudlac, Maureen T.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Lewis Research Center, in conjunction with Boeing North American, has been supporting the High Energy Upper Stage (HEUS) program by performing feasibility studies at Lewis Supplemental Multilayer Insulation Research Facility (SMIRF). These tests were performed to demonstrate the feasibility of chilling and filling a tank with liquid hydrogen in under 5 minutes. The goal of the HEUS program is to release a satellite from the shuttle cargo bay and then use a cryogenic (high-energy) upper stage to allow the satellite to achieve final orbit. Because of safety considerations, the propellant tanks for the upper stage will be launched warm and dry. They will be filled from the shuttle's external tank during the mission phase after the solid rocket boosters have jettisoned and prior to jettison of the external tank. Data from previous shuttle missions have been analyzed to ensure that sufficient propellant would be available in the external tank to fill the propellant tank of the proposed vehicle upper stage. Because of mission time-line considerations, the propellant tanks for the upper stage will have to be chilled down and filled in approximately 5 minutes. An existing uninsulated flight weight test tank was installed inside the vacuum chamber at SMIRF, and the chamber was evacuated to the 10(exp -5) torr range to simulate space vacuum conditions in the cargo bay with the doors open. During prerun operations, the facility liquid hydrogen (LH2) supply piping was prechilled with the vent gas bypassing the test article. The liquid hydrogen supply dewar was saturated at local ambient pressure and then pressurized with ambient temperature gaseous helium to the test pressure. A control system was used to ensure that the liquid hydrogen supply pressure was maintained at the test pressure.
Derived from text
Cryogenic Cooling; Liquid Cooling; Liquid Hydrogen; Heus Rocket Engines; Cryogenic Rocket Propellants; Cryogenic Tanks; Filling

20050189200 NASA Lewis Research Center, Cleveland, OH, USA
Zero Boiloff Storage of Cryogenic Propellants Achieved at Lewis' Supplemental Multilayer Insulation Research Facility
Plachta, David W.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Tests conducted at the NASA Lewis Research Center's Supplemental Multilayer Insulation Research Facility (SMIRF) demonstrated that a hybrid thermal control system could eliminate boiloff of cryogenic propellants. This is significant because of the substantial mass and cost savings that could be achieved for any long-duration space mission that requires cryogenic propellants. With long-duration cryogenic storage, propellants will boil off because of the environmental heating of the tank.

To accommodate these losses, extra propellant is required along with larger propellant tanks. Analysis of Mars mission scenarios using space-transfer cryogenic stages showed that significant savings in propellant mass and tank size could be achieved if it were possible to eliminate or significantly reduce propellant boiloff. Engineers and technicians at NASA Lewis designed, built, and tested a hybrid thermal control system to eliminate or significantly reduce cryogenic propellant boiloff. The system consists of an active cryocooling system using a cryocooler in addition to the traditional passive thermal insulation, as shown in the photo.
Author
Cryogenic Fluid Storage; Cryogenic Rocket Propellants; Temperature Control; Cryogenic Cooling

20050192147 NASA Glenn Research Center, Cleveland, OH, USA
Emerging Fuel Cell Technology Being Developed: Offers Many Benefits to Air Vehicles
Walker, James F.; Civinskas, Kestutis C.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Fuel cells, which have recently received considerable attention for terrestrial applications ranging from automobiles to stationary power generation, may enable new aerospace missions as well as offer fuel savings, quiet operations, and reduced emissions for current and future aircraft. NASA has extensive experience with fuel cells, having used them on manned space flight systems over four decades. Consequently, the NASA Glenn Research Center has initiated an effort to investigate and develop fuel cell technologies for multiple aerospace applications. Two promising fuel cell types are the proton exchange membrane (PEM) and solid oxide fuel cell (SOFC). PEM technology, first used on the Gemini spacecraft in the sixties, remained unutilized thereafter until the automotive industry recently recognized the potential. PEM fuel cells are low-temperature devices offering quick startup time but requiring relatively pure hydrogen fuel. In contrast, SOFCs operate at high temperatures and tolerate higher levels of impurities. This flexibility allows SOFCs to use hydrocarbon fuels, which is an important factor considering our current liquid petroleum infrastructure. However, depending on the specific application, either PEM or SOFC can be attractive. As only NASA can, the Agency is pursuing fuel cell technology for civil uninhabited aerial vehicles (UAVs) because it offers enhanced scientific capabilities, including enabling highaltitude, long-endurance missions. The NASA Helios aircraft demonstrated altitudes approaching 100,000 ft using solar power in 2001, and future plans include the development of a regenerative PEM fuel cell to provide nighttime power. Unique to NASA's mission, the high-altitude aircraft application requires the PEM fuel cell to operate on pure oxygen, instead of the air typical of terrestrial applications.
Derived from text
Fuel Cells; Technology Utilization; Aerospace Engineering; Aerospace Vehicles; NASA Space Programs

20050192208 NASA Glenn Research Center, Cleveland, OH, USA
Silicon Nitride Rocket Thrusters Test Fired Successfully
Eckel, Andrew J.; Research and Technology 1999; March 2000; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In-situ-toughened silicon nitride offers high strength, low density, and good thermal shock resistance. In previous research on flat coupons at the NASA Glenn Research Center at Lewis Field, it was identified as one of the few monolithic ceramic materials capable of surviving the severe thermal shock and thermal gradients generated in hydrogen/oxygen rocket engines. To demonstrate this capability in a complex configuration, a team from Glenn and Case Western Reserve University used advanced rapid prototyping technology to fabricate a 1-in.-diameter, single-piece combustion chamber/nozzle (thruster) component. Compliant seals were used to attach the net-shape-fabricated uncooled thruster to a water-cooled metallic propellant injector assembly. Then, the thruster was successfully hot-fire tested with hydrogen/oxygen propellant. The thruster survived five cycles including a 5-min cycle to a 2400 F material temperature. Silicon nitride can now be considered a viable candidate for some small rocket thruster applications. The research is expected to continue with increasingly larger and more complex geometries being fabricated and tested in a broad range of rocket engine operating conditions.
Author
Rocket Engines; Silicon Nitrides; Test Firing; Fabrication

20050192238 NASA Glenn Research Center, Cleveland, OH, USA
High-Performance Monopropellants and Catalysts Evaluated
Reed, Brian D.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center is sponsoring efforts to develop advanced monopropellant technology. The focus has been on monopropellant formulations composed of an aqueous solution of hydroxylammonium nitrate (HAN) and a fuel

component. HAN-based monopropellants do not have a toxic vapor and do not need the extraordinary procedures for storage, handling, and disposal required of hydrazine (N2H4). Generically, HAN-based monopropellants are denser and have lower freezing points than N2H4. The performance of HAN-based monopropellants depends on the selection of fuel, the HAN-to-fuel ratio, and the amount of water in the formulation. HAN-based monopropellants are not seen as a replacement for N2H4 per se, but rather as a propulsion option in their own right. For example, HAN-based monopropellants would prove beneficial to the orbit insertion of small, power-limited satellites because of this propellant's high performance (reduced system mass), high density (reduced system volume), and low freezing point (elimination of tank and line heaters). Under a Glenn-contracted effort, Aerojet Redmond Rocket Center conducted testing to provide the foundation for the development of monopropellant thrusters with an I(sub sp) goal of 250 sec. A modular, workhorse reactor (representative of a 1-lbf thruster) was used to evaluate HAN formulations with catalyst materials. Stoichiometric, oxygen-rich, and fuelrich formulations of HAN-methanol and HAN-tris(aminoethyl)amine trinitrate were tested to investigate the effects of stoichiometry on combustion behavior. Aerojet found that fuelrich formulations degrade the catalyst and reactor faster than oxygen-rich and stoichiometric formulations do. A HAN-methanol formulation with a theoretical Isp of 269 sec (designated HAN269MEO) was selected as the baseline. With a combustion efficiency of at least 93 percent demonstrated for HAN-based monopropellants, HAN269MEO will meet the I(sub sp) 250 sec goal.
Derived from text
Monopropellants; Catalysts; Aqueous Solutions; Ammonium Nitrates; Hydroxyl Compounds; Specific Impulse

20050192253 NASA Glenn Research Center, Cleveland, OH, USA
New High-Temperature Membranes Developed for Proton Exchange Membrane Fuel Cells
Kinder, James D.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Fuel cells are receiving a considerable amount of attention for potential use in a variety of areas, including the automotive industry, commercial power generation, and personal electronics. Research at the NASA Glenn Research Center has focused on the development of fuel cells for use in aerospace power systems for aircraft, unmanned air vehicles, and space transportation systems. These applications require fuel cells with higher power densities and better durability than what is required for nonaerospace uses. In addition, membrane cost is a concern for any fuel cell application. The most widely used membrane materials for proton exchange membrane (PEM) fuel cells are based on sulfonated perfluorinated polyethers, typically Nafion 117, Flemion, or Aciplex. However, these polymers are costly and do not function well at temperatures above 80 C. At higher temperatures, conventional membrane materials dry out and lose their ability to conduct protons, essential for the operation of the fuel cell. Increasing the operating temperature of PEM fuel cells from 80 to 120 C would significantly increase their power densities and enhance their durability by reducing the susceptibility of the electrode catalysts to carbon monoxide poisoning. Glenn's Polymers Branch has focused on developing new, low-cost membranes that can operate at these higher temperatures. A new series of organically modified siloxane (ORMOSIL) polymers were synthesized for use as membrane materials in a high-temperature PEM fuel cell. These polymers have an organic portion that can allow protons to transport through the polymer film and a cross-linked silica network that gives the polymers dimensional stability. These flexible xerogel polymer films are thermally stable, with decomposition onset as high as 380 C. Two types of proton-conducting ORMOSIL films have been produced: (1) NASA-A, which can coordinate many highly acid inorganic salts that facilitate proton conduction and (2) NASA-B, which has been produced and which incorporates strongly acidic (proton donating) functional groups into the polymer backbone. Both of these polymer films have demonstrated significantly higher proton conductivity than Nafion at elevated temperatures and low relative humidities. An added advantage is that these polymers are very inexpensive to produce because their starting materials are commodity chemicals that are commercially available in large volumes.
Author
Fuel Cells; High Temperature; Membranes; Protons; Polymers

20050192333 NASA Glenn Research Center, Cleveland, OH, USA
Advanced Monopropellant Thruster Technology Tested
Reed, Brian D.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A new family of environmentally friendly, low-freezing-point, high-density monopropellants is being developed under a NASA Glenn technology program. New monopropellant technology would greatly benefit a range of small (\h100 kg) satellites and spacecraft missions. These monopropellants are mixtures of hydroxylammonium nitrate (HAN), fuel, and water. Primex Aerospace Company, under contract to the NASA Glenn Research Center at Lewis Field, tested a 1-lbf thruster using

a HAN-based monopropellant formulation. Over 8000 sec of total test time was accumulated on a single thruster using the blowdown duty cycle typical of state-of-the-art monopropellant systems.
Derived from text
Monopropellants; Propulsion

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SPACE PROCESSING

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy*.

20050192125 NASA Lewis Research Center, Cleveland, OH, USA
Viscosity of Xenon Examined in Microgravity
Zimmerli, Gregory A.; Berg, Robert F.; Moldover, Michael R.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Why does water flow faster than honey? The short answer, that honey has a greater viscosity, merely rephrases the question. The fundamental answer is that viscosity originates in the interactions between a fluid s molecules. These interactions are so complicated that, except for low-density gases, the viscosity of a fluid cannot be accurately predicted. Progress in understanding viscosity has been made by studying moderately dense gases and, more recently, fluids near the critical point. Modern theories predict a universal behavior for all pure fluids near the liquid-vapor critical point, and they relate the increase in viscosity to spontaneous fluctuations in density near this point. The Critical Viscosity of Xenon (CVX) experiment tested these theories with unprecedented precision when it flew aboard the Space Shuttle Discovery (STS-85) in August 1997. Near the critical point, xenon is a billion times more compressible than water, yet it has about the same density. Because the fluid is so 'soft,' it collapses under its own weight when exposed to the force of Earth s gravity - much like a very soft spring. Because the CVX experiment is conducted in microgravity, it achieves a very uniform fluid density even very close to the critical point. At the heart of the CVX experiment is a novel viscometer built around a small nickel screen. An oscillating electric field forces the screen to oscillate between pairs of electrodes. Viscosity, which dampens the oscillations, can be calculated by measuring the screen motion and the force applied to the screen. So that the fluid s delicate state near the critical point will not be disrupted, the screen oscillations are set to be both slow and small.
Derived from text
Xenon; Viscosity; Spaceborne Experiments; Viscometers

20050192137 NASA Lewis Research Center, Cleveland, OH, USA
Crystal Growth Using MEPHISTO
deGroh, Henry C., III; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The shuttle flight experiment 'In Situ Monitoring of Crystal Growth Using MEPHISTO' was accomplished during STS-87 as part of the fourth flight of the USA Microgravity Payload (USMP-4), which was flown from November 19 to December 5, 1997. The data returned from that flight are just now beginning to yield quantitative results. This project is an international collaboration: the furnace system known as MEPHISTO was built in France by CNES (French National Space Agency) and CEA (French Atomic Energy Commission); the principal investigator, Prof. Reza Abbaschian, is from the University of Florida at Gainesville; and numerical and analytical modeling support includes collaborators from the University of New South Wales, Australia, the University of Wisconsin at Milwaukee, the National Institute of Standards and Technology, and the NASA Lewis Research Center. MEPHISTO is a French acronym that translates into English as Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit. Since this was the fourth flight of the MEPHISTO furnace, the experiment is referred to as MEPHISTO-4. MEPHISTO-4 was a directional solidification experiment that studied the liquid-to-solid transformation of bismuth alloyed with tin. Directional solidification is a freezing technique common to the processing of the electronic materials used in integrated circuits and detectors, such as silicon and germanium. When liquids are frozen on Earth, they must be cooled. The cooling causes stirring because of density variations in the liquid. This stirring, known as natural convection, influences the quality of the resulting solid. During freezing, regions of high and low concentrations of tin are created. This introduces another important phenomenon: diffusion, or the movement by molecular action of matter from regions of high concentration to regions of lower concentration. In MEPHISTO-4, it is tin that diffuses

from the high-concentration region in front of the solid-liquid interface to more distant low-concentration regions.
Derived from text
Crystal Growth; Spaceborne Experiments; Directional Solidification (Crystals); Space Shuttle Payloads; French Space Program; Furnaces; Phase Transformations; Bismuth Alloys

32
COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. 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 and Safety*.

20050186915 National Inst. of Information and Communications Technology, Tokyo, Japan
Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2
Takahashi, Tetsuo, Editor; Tomita, Fumihiko, Editor; Kurihara, Noriyuki, Editor; Umezu, Jun, Editor; March/June 2004; ISSN 1349-3205; 218 pp.; In English; See also 20050186916 - 20050186935; Original contains color and black and white illustrations; Copyright; Avail: Other Sources

Most of the papers in this issue are grouped into the following sections: 1) Optical COE (Center of Excel1ence) Project; 2) Light Source Technology; 3) Photonics Technologies; 4) Wavefront Control Technologies; 5) Optical Communication Technologies; 6) Wind Profile Measurements by Coherent Doppler Lidar.
CASI
Optical Communication; Communication Networks; Communication Equipment; Wireless Communication; Space Communication

20050186916 National Inst. of Information and Communications Technology, Tokyo, Japan
Fourier Synthesis of Optical Pulses
Hyodo, Masaharu; Onodera, Noriaki; Abedin, Kazi Sarwar; Watanabe, Masayoshi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 3-16; In English; See also 20050186915; Copyright; Avail: Other Sources

With the rapid progress made recently in the field of optical communication technology, much attention is being focused on the techniques for generating ultrafast optical pulses with an ultra-high repetition frequency. Fourier synthesis is one of the most promising techniques for doing this, because, unlike in conventional techniques such as mode-locking, there is no limitation on having an arbitrarily high repetition frequency. Fourier synthesis is also used to synthesize arbitrary waveforms based on the inverse process of Fourier-series expansion. We have demonstrated the generation of ultrafast optical pulses with repetition frequencies from 9.6 GHz to as high as 1.8 THz by synthesizing the outputs from three independently oscillating semiconductor lasers. We have also demonstrated that the Fourier-synthesized pulses could be synchronized to an external optical clock. This paper describes the outlines of the above experiments as well as a technique for successive generation of arbitrary bit streams.
Author
Optical Communication; Pulse Communication; Fourier Series; Series Expansion

20050186917 National Inst. of Information and Communications Technology, Japan
Optical Modulators for Photonic Sideband Management
Kawanishi, Tetsuya; Izutsu, Masayuki; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 41-50; In English; See also 20050186915; Copyright; Avail: Other Sources

In this paper, we presented our recent works on development of optical modulators and subsystems. The modulators have new functions, such as optical frequency shift, modulation by radio-frequency-signal, etc, in addition to conventional ON/OFF keying. The target of our works is to provide particular functions for novel systems, such as radio-on-fiber system, optical packet switching, etc.
Author
Light Modulators; Sidebands; Optical Communication

20050186919 National Inst. of Information and Communications Technology, Japan

Optical Chaos CDMA

Umeno, Ken; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 163-166; In English; See also 20050186915; Copyright; Avail: Other Sources

Ultrafast secure communication systems are proposed based on applications of chaos theory to designing optical pulse code for optical CDMA. Chaotic optical pulse code generator was recently fabricated on a planar lightwave circuit for optical Chaos CDMA. We experimentally demonstrate 10 Gbit/s transmission by using chaotic pulse code generators.

Author

Chaos; Code Division Multiple Access; Fabrication; Telecommunication; Optical Communication

20050186921 National Inst. of Information and Communications Technology, Japan

Research on Superconductive Oscillators and Detectors at Terahertz Frequency Regions

Wang, Zhen; Kawakami, Akira; Uzawa, Yoshinori; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 27-39; In English; See also 20050186915; Copyright; Avail: Other Sources

Development of generating and detecting technology in the THz frequency region is an important subject for high-speed telecommunication technology in the future. Recently, it is necessary to develop THz-band oscillators and detectors in the field of globe environment measurements and radio physics. We have developed superconducting Josephson array oscillators and low-noise SIS mixers for THz-band solid oscillator and highly sensitive detector. In this paper, we show oscillating properties and frequency dependence of output for 650 GHz and 1 THz Josephson array oscillator, and discuss low-noise properties of 800 GHz-band SIS mixers.

Author

SIS (Superconductors); Communication Equipment; Oscillators

20050186926 National Inst. of Information and Communications Technology, Japan

Ultra-fast Optical Processing Technology and its Application to Photonic Network

Wada, Naoya; Kubota, Fumito; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 151-161; In English; See also 20050186915; Copyright; Avail: Other Sources

Ultra-high speed all-optical label processing methods are proposed and experimentally demonstrated.These methods dramatically increase the label processing capability. Optical packet switch (OPS) systems and networks based on OPS nodes are expressed as an application of optical processing technologies. First 40 Gbit/s/port OPS prototype with all-optical label processor, optical switch, optical buffer, and electronic scheduler is expressed. The feasibility of OPS networks is verified by experimental demonstrations.

Author

Optical Data Processing; Packet Switching; Communication Networks; Optical Communication

20050186933 National Inst. of Information and Communications Technology, Japan

High-Spectral Density Multiplexing Transmission and Photonic Mixing for Millimeter-Wave-Band Radio-on-Fiber Systems

Kuri, Toshiaki; Yamashita, Tsukasa; Toda, Hiroyuki; Kitayama, Ken-ichi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 133-139; In English; See also 20050186915; Copyright; Avail: Other Sources

Two system architectures based on dense wavelength division multiplexing (DWDM) for millimeter-wave-band (mm-wave-band) radio-on-fiber (ROF) systems are described. One architecture consists of a wavelength multiplexer and demultiplexer with arrayed waveguide gratings (AWGs) for optical-frequency-interleaved DWDM ROF transmission. The other architecture is based on a photonic down-conversion technique that is used in DWDM ROF systems. A 25-GHz-spaced, 60-GHz-band DWDM ROF transmission with photonic down-conversion is experimentally demonstrated.

Author

Wavelength Division Multiplexing; Millimeter Waves; Microwave Transmission; Data Transmission

20050186934 National Inst. of Information and Communications Technology, Tokyo, Japan

Photonic Antennas and its Application to Radio-over-Fiber Wireless Communication Systems

Li, Keren; Izutsu, Masayuki; Matsui, Toshiaki; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 141-149; In English; See also 20050186915; Copyright; Avail: Other Sources

In this paper, we presented our recent works on development of photonic feeding coplanar patch antennas for microwave and millimeter-wave wireless communication system. An experiment setup for optical modulation of subcarrier, photodetection of the subcarrier-modulated optical wave and integration of the photodetector with a coplanar patch antenna have been described. Experimental results of optical modulation using a traveling-wave LiNbO3 optical modulator, RF output from a photodetector: UTC-PD, and the RF output dependence on modulation index have been presented and discussed. The experiment showed that the photodetector can generate relatively large RF power at microwave and millimeter-wave frequencies, for example, more than 10 mW at both 10 GHz and 20 GHz and around 10 mW at 38 GHz and 7 mW at 60 GHz. Based on this experimental fact, we introduced a concept of direct integration of an antenna with the photodetector to realize a simple photonic feeding RF radiation unit to avoid serious transmission loss and simplify the RF system especially in high frequency wireless system. A planar antenna: coplanar patch antenna was newly proposed and designed for the direct integration with the photodetector which is of a coplanar waveguide output structure. Simulation, design, fabrication and measurement have been done for the antennas. Experiment on a hybrid integration of the photodetector and the coplanar patch antenna demonstrated a good performance of photonic microwave generating, direct feeding, transmitting and receiving. The results clearly showed the effectiveness and the potential application of our integration configuration to the future microwave and millimeter-wave wireless communication system based on the optical fiber network.

Author

Planar Structures; Patch Antennas; Microwave Antennas; Millimeter Waves; Wireless Communication

20050187032 Department of Justice, Washington, DC, USA

Federal Bureau of Investigation's Management of the Trilogy Information Technology Modernization Project

Feb. 2005; 100 pp.; In English

Report No.(s): PB2005-106966; REPT-05-07; No Copyright; Avail: CASI; A05, Hardcopy

This audit assesses the progress of the Federal Bureau of Investigation's (FBI) Trilogy project. Initiated in mid-2001, the objective of Trilogy is to modernize the FBI's information technology (IT) infrastructure; provide needed IT applications for FBI agents, analysts, and others to efficiently and effectively do their jobs; and lay the foundation for future IT improvements in the FBI. Trilogy consists of three parts: (1) upgrading the FBI's hardware and software, (2) upgrading of the FBI's communications network, and (3) upgrading the FBI's five most important investigative applications, including its antiquated case management system. Because of the FBI's immediate and critical need for modern IT systems and the past problems in the Trilogy project, we conducted this audit to assess the FBI's progress in meeting cost, schedule, technical, and performance targets for the three components of Trilogy. We also examined the extent to which Trilogy will meet the FBI's current and longer-term IT needs.

NTIS

Information Management; Information Systems; Management Information Systems; Project Management

20050187054 Economics and Statistics Administration, Washington, DC, USA

Information and Communication Technology: 2003

Jun. 2005; 56 pp.; In English

Report No.(s): PB2005-108224; ICT/03; No Copyright; Avail: CASI; A04, Hardcopy

The Information and Communication Technology Survey (ICTS), a supplement to the Annual Capital Expenditures Survey (ACES), was created in response to economic data user and policymaker concerns about the lack of available data on e-business infrastructure investment by nonfarm businesses. Rapid changes and advances in information and communication technology (ICT) equipment have resulted in these assets having short useful lives and a tendency to be replaced much quicker than other types of equipment. Companies are expensing the full cost of such assets during the current annual period rather than capitalizing the value of such assets and expensing the cost over two or more years. In some cases this is due to the short useful life of the asset, and in other cases this is because companies have varying dollar levels for capitalization. The ICTS data are critical for providing improved source data to the investment component of gross domestic product, capital stock estimates, and capital flow tables. The data will also be used to assess future productivity and economic growth prospects. In

addition, the data provide facts about trends in such expenditures useful for identifying business opportunities, product development, and business planning.
NTIS
Information Systems; Communication Equipment; Product Development

20050188509 NASA Lewis Research Center, Cleveland, OH, USA
Conformal, Transparent Printed Antenna Developed for Communication and Navigation Systems
Lee, Richard Q.; Simons, Rainee N.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Conformal, transparent printed antennas have advantages over conventional antennas in terms of space reuse and aesthetics. Because of their compactness and thin profile, these antennas can be mounted on video displays for efficient integration in communication systems such as palmtop computers, digital telephones, and flat-panel television displays. As an array of multiple elements, the antenna subsystem may save weight by reusing space (via vertical stacking) on photovoltaic arrays or on Earth-facing sensors. Also, the antenna could go unnoticed on automobile windshields or building windows, enabling satellite uplinks and downlinks or other emerging high-frequency communications.
Derived from text
Antennas; Antenna Design; Communication

20050188513 NASA Lewis Research Center, Cleveland, OH, USA
Bandwidth Efficient Wireless Digital Modem Developed
Kifle, Muli; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Lewis Research Center has developed a digital approach for broadcasting highfidelity audio (nearly compact disk (CD) quality sound) in the commercial frequencymodulated (FM) broadcast band. This digital approach provides a means of achieving high data transmission rates with low hardware complexity--including low mass, size, and power consumption. Lewis has completed the design and prototype development of a bandwidth-efficient digital modem (modulator and demodulator) that uses a spectrally efficient modulation scheme: 16-ary rectangular quadrature amplitude modulation, or 16-ary QAM. The digital implementation is based strictly on inexpensive, commercial off-theshelf digital signal processing (DSP) hardware to perform up and down conversions and pulse shaping. The digital modem transmits data at rates up to 76 kilobits per second (kbps), which is almost 3 times faster than standard 28.8-kbps telephone modems. In addition, the modem offers improved power and spectral performance, flexible operation, and low-cost implementation.
Derived from text
Bandwidth; Broadcasting; Data Transmission; Signal Processing; Wireless Communication

20050188514 NASA Lewis Research Center, Cleveland, OH, USA
622-Mbps Orthogonal Frequency Division Multiplexing Modulator Developed
Nguyen, Na T.; Research and Technology 1998; April 1999; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Communications Technology Division at the NASA Lewis Research Center is developing advanced electronic technologies for the space communications and remote sensing systems of tomorrow. As part of the continuing effort to advance the state-of-the art in satellite communications and remote sensing systems, Lewis is developing a programmable Orthogonal Frequency Division Multiplexing (OFDM) modulator card for high-data-rate communication links. The OFDM modulator is particularly suited to high data-rate downlinks to ground terminals or direct data downlinks from near-Earth science platforms. It can support data rates up to 622 megabits per second (Mbps) and high-order modulation schemes such as 16-ary quadrature amplitude modulation (16-ary QAM) or 8- phase shift keying (8PSK). High order modulations can obtain the bandwidth efficiency over the traditional binary phase shift keying (BPSK) or quadrature phase shift keying (QPSK) modulator schemes. The OFDM modulator architecture can also be precompensated for channel disturbances and alleviate amplitude degradations caused by nonlinear transponder characteristics.
Author
Satellite Communication; Space Communication; Modulators; Communication Networks; Frequency Division Multiplexing

20050188519 NASA Lewis Research Center, Cleveland, OH, USA
Thin-Film Ferroelectric Tunable Microwave Devices Being Developed
VanKeuls, Frederick W.; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Electronically tunable microwave components have become the subject of intense research efforts in recent years. Many new communications systems would greatly benefit from these components. For example, planned low Earth orbiting satellite networks have a need for electronically scanned antennas. Thin ferroelectric films are one of the major technologies competing to fill these applications. When a direct-current (dc) voltage is applied to ferroelectric film, the dielectric constant of the film can be decreased by nearly an order of magnitude, changing the high-frequency wavelength in the microwave device. Recent advances in film growth have demonstrated high-quality ferroelectric thin films. This technology may allow microwave devices that have very low power and are compact, lightweight, simple, robust, planar, voltage tunable, and affordable. The NASA Lewis Research Center has been designing, fabricating, and testing proof-of-concept tunable microwave devices. This work, which is being done in-house with funding from the Lewis Director's Discretionary Fund, is focusing on introducing better microwave designs to utilize these materials. We have demonstrated Ku- and K-band phase shifters, tunable local oscillators, tunable filters, and tunable diplexers. Many of our devices employ SrTiO3 as the ferroelectric. Although it is one of the more tunable and easily grown ferroelectrics, SrTiO3 must be used at cryogenic temperatures, usually below 100 K. At these temperatures, we frequently use high-temperature superconducting thin films of YBa2Cu3O7-8 to carry the microwave signals. However, much of our recent work has concentrated on inserting room-temperature ferroelectric thin films, such as BaxSr1- xTiO3 into these devices. The BaxSr1-xTiO3 films are used in conjuction with normal metal conductors, such as gold.

Derived from text

Ferromagnetic Films; Ferroelectricity; Microwave Antennas

20050188525 NASA Lewis Research Center, Cleveland, OH, USA

Web Transfer Over Satellites Being Improved

Allman, Mark; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Extensive research conducted by NASA Lewis Research Center's Satellite Networks and Architectures Branch and the Ohio University has demonstrated performance improvements in World Wide Web transfers over satellite-based networks. The use of a new version of the Hypertext Transfer Protocol (HTTP) reduced the time required to load web pages over a single Transmission Control Protocol (TCP) connection traversing a satellite channel. However, an older technique of simultaneously making multiple requests of a given server has been shown to provide even faster transfer time. Unfortunately, the use of multiple simultaneous requests has been shown to be harmful to the network in general. Therefore, we are developing new mechanisms for the HTTP protocol which may allow a single request at any given time to perform as well as, or better than, multiple simultaneous requests. In the course of study, we also demonstrated that the time for web pages to load is at least as short via a satellite link as it is via a standard 28.8-kbps dialup modem channel. This demonstrates that satellites are a viable means of accessing the Internet.

Derived from text

Communication Satellites; World Wide Web; Data Transmission

20050188526 NASA Lewis Research Center, Cleveland, OH, USA

Advances Made in the Next Generation of Satellite Networks

Bhasin, Kul B.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Because of the unique networking characteristics of communications satellites, global satellite networks are moving to the forefront in enhancing national and global information infrastructures. Simultaneously, broadband data services, which are emerging as the major market driver for future satellite and terrestrial networks, are being widely acknowledged as the foundation for an efficient global information infrastructure. In the past 2 years, various task forces and working groups around the globe have identified pivotal topics and key issues to address if we are to realize such networks in a timely fashion. In response, industry, government, and academia undertook efforts to address these topics and issues. A workshop was organized to provide a forum to assess the current state-of-the-art, identify key issues, and highlight the emerging trends in the next-generation architectures, data protocol development, communication interoperability, and applications. The Satellite Networks: Architectures, Applications, and Technologies Workshop was hosted by the Space Communication Program at the NASA Lewis Research Center in Cleveland, Ohio. Nearly 300 executives and technical experts from academia, industry, and government, representing the USA and eight other countries, attended the event (June 2 to 4, 1998). The program included seven panels and invited sessions and nine breakout sessions in which 42 speakers presented on technical topics. The proceedings covers a wide range of topics: access technology and protocols, architectures and network simulations, asynchronous transfer mode (ATM) over satellite networks, Internet over satellite networks, interoperability experiments and applications, multicasting, NASA interoperability experiment programs, NASA mission applications, and Transmission

Control Protocol/Internet Protocol (TCP/IP) over satellite: issues, relevance, and experience.
Author
Satellite Networks; Satellite Communication; Conferences; Communication Networks

20050188527 NASA Lewis Research Center, Cleveland, OH, USA
Internet Protocol Enhanced over Satellite Networks
Ivancic, William D.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Extensive research conducted by the Satellite Networks and Architectures Branch of the NASA Lewis Research Center led to an experimental change to the Internet's Transmission Control Protocol (TCP) that will increase performance over satellite channels. The change raises the size of the initial burst of data TCP can send from 1 packet to 4 packets or roughly 4 kilobytes (kB), whichever is less. TCP is used daily by everyone on the Internet for e-mail and World Wide Web access, as well as other services. TCP is one of the feature protocols used in computer communications for reliable data delivery and file transfer. Increasing TCP's initial data burst from the previously specified single segment to approximately 4 kB may improve data transfer rates by up to 27 percent for very small files. This is significant because most file transfers in wide-area networks today are small files, 4 kilobytes or less. In addition, because data transfers over geostationary satellites can take 5 to 20 times longer than over typical terrestrial connections, increasing the initial burst of data that can be sent is extremely important. This research along with research from other institutions has led to the release of two new Request for Comments from the Internet Engineering Task Force (IETF, the international body that sets Internet standards). In addition, two studies of the implications of this mechanism were also funded by NASA Lewis.
Author
Satellite Networks; Internets; Data Transmission; Protocol (Computers); Satellite Communication

20050188528 NASA Lewis Research Center, Cleveland, OH, USA
Satellite ATM Networks: Architectures and Guidelines Developed
vonDeak, Thomas C.; Yegendu, Ferit; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

An important element of satellite-supported asynchronous transfer mode (ATM) networking will involve support for the routing and rerouting of active connections. Work published under the auspices of the Telecommunications Industry Association (http://www.tiaonline.org), describes basic architectures and routing protocol issues for satellite ATM (SATATM) networks. The architectures and issues identified will serve as a basis for further development of technical specifications for these SATATM networks. Three ATM network architectures for bent pipe satellites and three ATM network architectures for satellites with onboard ATM switches were developed. The architectures differ from one another in terms of required level of mobility, supported data rates, supported terrestrial interfaces, and onboard processing and switching requirements. The documentation addresses low-, middle-, and geosynchronous-Earth-orbit satellite configurations. The satellite environment may require real-time routing to support the mobility of end devices and nodes of the ATM network itself. This requires the network to be able to reroute active circuits in real time. In addition to supporting mobility, rerouting can also be used to (1) optimize network routing, (2) respond to changing quality-of-service requirements, and (3) provide a fault tolerance mechanism. Traffic management and control functions are necessary in ATM to ensure that the quality-of-service requirements associated with each connection are not violated and also to provide flow and congestion control functions. Functions related to traffic management were identified and described. Most of these traffic management functions will be supported by on-ground ATM switches, but in a hybrid terrestrial-satellite ATM network, some of the traffic management functions may have to be supported by the onboard satellite ATM switch. Future work is planned to examine the tradeoffs of placing traffic management functions onboard a satellite as opposed to implementing those functions at the Earth station components.
Derived from text
Satellite Networks; Satellite Communication; Asynchronous Transfer Mode; Network Control

20050189220 Fermi National Accelerator Lab., Batavia, IL, USA
Multi-Session Bridge
Roediger, G. A.; Lidinsky, W. P.; Feb. 1998; 12 pp.; In English
Report No.(s): DE2005-16724; FERMILAB-CONF-98/061; No Copyright; Avail: Department of Energy Information Bridge

The Multicast BackbONE (MBone) is heavily used to carry Internet video conferences. The low cost and ease-of-use have made the MBone and its associated tools (e.g., sdr, vat, vic, wb) very popular. But HEP video conferences often requires

many-to-many sparse network topologies, an arrangement that cannot easily take advantage of MBone efficiencies. Moreover, many HEP sites do not support multicast and thus researchers at those sites are cut off from important meetings. In addition, the topology of the MBone can cause poor performance or lack of access for some sites. To solve these problems, HEPNRC has developed the Multi-Session Bridge (msb) and its support tool vtc. The msb allows an arbitrary number of multicast and unicast sessions to be connected in one or more seamless video conferences. Multiple msbs can also be connected to form a conference virtual network. The msb also extends MBone sessions to non-MBone sites through unicast streams. The msb is being extended to provide secure communications.
NTIS
Teleconferencing; Video Communication; Video Conferencing

20050189257 Consumer Product Safety Commission, Bethesda, MD, USA
Hazard Screening Report: Home Communications, Entertainment, and Hobby. (Product Codes 514, 519, 529-533, 536, 545-547, 549-550, 552, 555-559, 561-566, 571-573)
Mar. 2005; 24 pp.; In English
Report No.(s): PB2005-107232; No Copyright; Avail: CASI; A03, Hardcopy
This report provides overall injury and death figures associated with the category of Home Communication, Entertainment and Hobby Products. The first information presented is a summary of the injury, death and cost data for the entire class of products. A trend graphic is presented which shows the frequency of estimated emergency room-treated injuries since 1997. This is followed by a chart showing the distribution of the injuries for this class of products by energy source of the hazard, i.e., mechanical, fire, electrical, chemical, or other. There is also a summary table, which shows the injuries, deaths, and costs associated with each product group. This report is one of a series of hazard screening reports. Each report provides information in a similar format to allow product and hazard comparison, both within and among the reports.
NTIS
Consumers; Hazards; Protection

20050192058 General Accounting Office, Washington, DC, USA
Internet Protocol Version 6: Federal Agencies Need to Plan for Transition and Manage Security Risks
May 2005; 46 pp.; In English
Report No.(s): PB2005-106866; GAO-05-471; No Copyright; Avail: CASI; A03, Hardcopy
The Internet protocol (IP) provide the addressing mechanism that defines how and where information such as text, voice, and video move across interconnected networks. Internet protocol version 4 (IPv4), which is widely used today, may not be able to accommodate the increasing number of global users and devices that are connecting to the Internet. As a result, IP version 6 (IPv6) was developed to increase the amount of available IP address space. GAO was asked to (1) describe the key characteristics of IPv6; (2) identify the key planning considerations for federal agencies in transitioning to IPv6; and (3) determine the progress made by the Department of Defense (DOD) and other major agencies to transition to IPv6.
NTIS
Internets; Protocol (Computers); Risk; Security

20050192118 NASA Lewis Research Center, Cleveland, OH, USA
Advanced Communications Technology Satellite Now Operating in an Inclined Orbit
Bauer, Robert A.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy
The Advanced Communications Technology Satellite (ACTS) system has been modified to support operation in an inclined orbit that is virtually transparent to users, and plans are to continue this final phase of its operation through September 2000. The next 2 years of ACTS will provide a new opportunity for using the technologies that this system brought online over 5 years ago and that are still being used to resolve the technical issues that face NASA and the satellite industry in the area of seamless networking and interoperability with terrestrial systems. New goals for ACTS have been defined that align the program with recent changes in NASA and industry. ACTS will be used as a testbed to: Show how NASA and other Government agencies can use commercial systems for 1. future support of their operations Test, characterize, and resolve technical issues in using advanced communications 2. protocols such as asynchronous transfer mode (ATM) and transmission control protocol/Internet protocol (TCP/IP) over long latency links as found when interoperating satellites with terrestrial systems Evaluate narrow-spot-beam Ka-band satellite operation in an inclined orbit 3. Verify Ka-band satellite technologies since no other Ka-band system is yet 4. available in the USA
Derived from text
Communication; ACTS; Asynchronous Transfer Mode; Protocol (Computers)

20050192378 NASA Glenn Research Center, Cleveland, OH, USA

Aircraft Icing Educational and Training Videos Produced for Pilots

VanZante, Judith Foss; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As a part of NASA s aviation safety mission, the Icing Branch of the NASA Glenn Research Center at Lewis Field is producing educational and training videos to help pilots recognize and recover from in-flight icing hazards. These videos are a result of experience gained from the NASA/FAA Tailplane Icing Program. The first educational video, 'Tailplane Icing,' was written and produced solely by NASA Glenn. The response following the September 1998 release has been overwhelming. Thus far, 700 copies have been distributed. A request soon came to produce more videos covering a wider range of topics. Released in November 1999 was 'Icing for Regional and Corporate Pilots.' This training video was cowritten by NASA, the Federal Aviation Administration (FAA), and the Air Line Pilots Association (ALPA). It is focused specifically on the pilots and aircraft most likely to encounter in-flight icing conditions. A video tailored specifically for general aviation pilots will be produced in the Fall of 2000 followed by an Icing Basics primer. The motivation for the educational video 'Tailplane Icing' (running time, 23 min) was to equip pilots with an understanding of ice-contaminated tailplane stall, the cause of at least 16 accidents and 139 fatalities. The video discusses the role of the horizontal tailplane, illustrates the 'paths to stall,' and explains why the procedure for recovery from a tail stall is exactly opposite that for a wing stall and how to recognize the subtle tactile differences between the two. The training video, 'Icing for Regional and Corporate Pilots,' is more comprehensive in scope. This 37-min video discusses ice protections systems, ice accretion physics, and the symptoms of ice accretion, the effects of ice on the aircraft in regards to both performance penalties and handling anomalies, recovery techniques, and finally, the phenomenon of supercooled large droplets (SLD's). It is available now. Find out more about these videos, or order them free of charge http://icebox-esn.grc.nasa.gov/ext/education/education.html.

Author

Aircraft Icing; Video Communication; Aircraft Pilots; Educational Resources; General Aviation Aircraft

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ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. for related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

20050186920 National Inst. of Information and Communications Technology, Japan

Atom Optics and Atom Lithography

Ohmukai, Ryuzo; Watanabe, Masayoshi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 17-25; In English; See also 20050186915; Copyright; Avail: Other Sources

High-resolution atomic channeling using velocity-selected atoms may be able to overcome precision limitations of the conventional atom lithography. We have experimentally clarified the dependence of line width and contrast of atomic patterns in the channeling region on the velocity spread of the atomic source for the first time. Thermal or velocity-selected atomic beams prepared with a one-dimensional magneto-optical trap were employed as the atomic sources. We can show that narrower line width and higher contrast atomic patterns are obtained as the velocity spread becomes narrower. We also successfully produced periodic ytterbium (Yb) narrow lines on a substrate using a near-resonant laser light and the direct-write atom lithography technique. We clearly observed a grating pattern of Yb atoms fabricated on a substrate with a line separation of approximately 200 nm after examining the surface of the substrate with an atomic force microscopy. This is the first demonstration of nanofabrication using the atom-optical approach with Yb atoms.

Author

Lithography; Atom Optics; Ytterbium

20050186924 National Inst. of Information and Communications Technology, Japan

Nano-Gate Transistor: World's Fastest InP-HEMT

Shinohara, Keisuke; Matsui, Toshiaki; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 95-102; In English; See also 20050186915; Copyright; Avail: Other Sources

InP-based InGaAs/InAlAs high electron mobility transistors (HEMTs) which can operate in the sub-millimeter-wave

frequency range (300 GHz - 3 THz) are key devices for future ultra-high-speed communications because of their high-frequency, low-noise performance. We succeeded in fabricating the world's shortest 25-nm-gate InP-HEMTs which exhibited a record current gain cutoff frequency (f(sub T)) of 562 GHz. Moreover, we investigated the effect of device structures on their high frequency performance, and it was greatly improved by optimizing these structural parameters.
Author
Nanostructures (Devices); Transistors; Indium Phosphides; Gates (Circuits)

20050186930 National Inst. of Information and Communications Technology, Japan
Mobile Whole-head SQUID System of SNS Junctions in a Superconducting Magnetic Shield
Ohta, Hiroshi; Matsui, Toshiaki; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 103-111; In English; See also 20050186915; Copyright; Avail: Other Sources

We have constructed a mobile whole-head SQUID system of SNS (Superconductor/Normal metaVSuperconductor) junctions in a superconducting magnetic shield. The whole-head SQUID system in the superconducting magnetic shield is 100 times more sensitive than that in a magnetically shielded room of Permalloy. Nanometer-scale SNS junctions have the comparable size to the wavelength of the beat of de Bloglie waves of an electron and a hole to be a mesoscopic system. The established theory of mesoscopic SNS junctions is as elegant as Planck theory of blackbody radiation. SQUID systems enable invasive studies about recognition in human brains. They have response time of millisecond to be a good tool for experimental confirmation of neural models of human brain obtaining information about memory, attention and learning in long latencies. They are expected to make some contribution to studies about autism, ADHD and LD. The SQUID system has successfully detected magnetic fields from human brains both in crowded Nan0 tech 2003 held at Makuhari Messe convention center and Nanotech 2004 at Tokyo Big Sight Exhibition Center. The success could be the first step to mobile clinic for mental care.
Author
SQUID (Detectors); Josephson Junctions; Magnetic Shielding; Medical Electronics

20050187012 NASA Lewis Research Center, Cleveland, OH, USA
Lithium-Ion Polymer Rechargeable Battery Developed for Aerospace and Military Applications
Hagedorn, orman H.; Research and Technology 1998; August 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A recently completed 3 -year project funded by the Defense Advanced Research Projects Agency (DARPA) under the Technology Reinvestment Program has resulted in the development and scaleup of new lithium-ion polymer battery technology for military and aerospace applications. The contractors for this cost-shared project were Lockheed Martin Missiles & Space and Ultralife Batteries, Inc. The NASA Lewis Research Center provided contract management and technical oversight. The final products of the project were a portable 15-volt (V), 10-ampere-hour (A-hr) military radio battery and a 30-V, 50-A-hr marine/aerospace battery. Lewis will test the 50-A-hr battery. The new lithium-ion polymer battery technology offers a threefold or fourfold reduction in mass and volume, relative to today s commonly used nickel-cadmium, nickel-hydrogen, and nickel-metal hydride batteries. This is of special importance for orbiting satellites. It has been determined for a particular commercial communications satellite that the replacement of 1 kg of battery mass with 1 kg of transponder mass could increase the annual revenue flow by $100 000! Since this lithium-ion polymer technology offers battery mass reductions on the order of hundreds of kilograms for some satellites, the potential revenue increases are impressive.
Author
Lithium; Electric Batteries; Nickel Compounds; Transponders; Metal Ions; Metal Hydrides; Aerospace Engineering

20050187021 NASA Lewis Research Center, Cleveland, OH, USA
Lightweight Battery Charge Regulator Used to Track Solar Array Peak Power
Soeder, James F.; Button, Robert M.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A battery charge regulator based on the series-connected boost regulator (SCBR) technology has been developed for high-voltage spacecraft applications. The SCBR regulates the solar array power during insolation to prevent battery overcharge or undercharge conditions. It can also be used to provide regulated battery output voltage to spacecraft loads if necessary. This technology uses industry-standard dc-dc converters and a unique interconnection to provide size, weight, efficiency, fault tolerance, and modularity benefits over existing systems. The high-voltage SCBR shown in the photograph has demonstrated power densities of over 1000 watts per kilogram (W/kg). Using four 150-W dc-dc converter modules, it can

process 2500 W of power at 120 Vdc with a minimum input voltage of 90 Vdc. Efficiency of the SCBR was 94 to 98 percent over the entire operational range. Internally, the unit is made of two separate SCBR s, each with its own analog control circuitry, to demonstrate the modularity of the technology. The analog controllers regulate the output current and incorporate the output voltage limit with active current sharing between the two units. They also include voltage and current telemetry, on/off control, and baseplate temperature sensors. For peak power tracking, the SCBR was connected to a LabView-based data acquisition system for telemetry and control. A digital control algorithm for tracking the peak power point of a solar array was developed using the principle of matching the source impedance with the load impedance for maximum energy transfer. The algorithm was successfully demonstrated in a simulated spacecraft electrical system at the Boeing PhantomWorks High Voltage Test Facility in Seattle, Washington. The system consists of a 42-string, high-voltage solar array simulator, a 77-cell, 80-ampere-hour (A-hr) nickel-hydrogen battery, and a constant power-load module. The SCBR and the LabView control algorithm successfully tracked the solar array peak power point through various load transients, including sunlight discharge transients when the total load exceeded the maximum solar array output power.
Author
Electric Batteries; High Voltages; Regulators; Energy Transfer; Fault Tolerance; Temperature Sensors

20050187110 Oak Ridge Y-12 Plant, TN, USA
Arc Flash Boundary Calculations Using Computer Software Tools
Gibbs, M. D.; Jan. 07, 2005; 12 pp.; In English
Report No.(s): DE2005-835742; Y/EN-8099; No Copyright; Avail: Department of Energy Information Bridge

Arc Flash Protection boundary calculations have become easier to perform with the availability of personal computer software. These programs incorporate arc flash protection boundary formulas for different voltage and current levels, calculate the bolted fault current at each bus, and use built in time-current coordination curves to determine the clearing time of protective devices in the system. Results of the arc flash protection boundary calculations can be presented in several different forms as an annotation to the one-line diagram, as a table of arc flash protection boundary distances, and as printed placards to be attached to the appropriate equipment. Basic arc flash protection boundary principles are presented in this paper along with several helpful suggestions for performing arc flash protection boundary calculations.
NTIS
Boundaries; Boundary Conditions; Computer Programs; Electric Arcs

20050188451 NASA Lewis Research Center, Cleveland, OH, USA
Low-Temperature Electronic Components Being Developed
Patterson, Richard L.; Hammond, Ahmad; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In many future NASA missions, such as deep space planetary exploration and the Next Generation Space Telescope, electrical components and systems must operate reliably and efficiently in extremely low temperature environments. Most modern electronic components cannot operate below moderately low operating temperatures (-40 to -55 C). The low-temperature electronics program at the NASA Lewis Research Center is focusing on the development and characterization of low-temperature components and the integration of the developed devices into demonstrable very low-temperature (-200 C) power systems such as dc-dc converters. Such low-temperature electronics will not only tolerate hostile environments but also will reduce system size and weight by eliminating radioisotope heating units, thereby reducing launch cost, improving reliability and lifetime, and increasing energy densities. Low-temperature electronic components will also have a great influence on terrestrial applications such as medical instrumentation, magnetic levitation transportation systems, and arctic and antarctic exploration. Lewis researchers are now performing extensive evaluations of commercially available as well as custom-made devices. These include various types of energy storage and signal capacitors, power switching devices, magnetic and superconducting materials, and primary lithium batteries, to name a few.
Derived from text
NASA Programs; Low Temperature Environments; Space Exploration; Spaceborne Telescopes; Voltage Converters (DC to DC)

20050188493 NASA Lewis Research Center, Cleveland, OH, USA
Finite Ground Coplanar (FGC) Waveguide: Characteristics and Advantages Evaluated for Radiofrequency and Wireless Communication Circuits
Ponchak, George E.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Researchers in NASA Lewis Research Center s Electron Device Technology Branch are developing transmission lines for radiofrequency and wireless circuits that are more efficient, smaller, and make lower cost circuits possible. Traditionally, radiofrequency and wireless circuits have employed a microstrip or coplanar waveguide to interconnect the various electrical elements that comprise a circuit. Although a coplanar waveguide (CPW) is widely viewed as better than a microstrip for most applications, it too has problems. To solve these problems, NASA Lewis and the University of Michigan developed a new version of a coplanar waveguide with electrically narrow ground planes. Through extensive numerical modeling and experimental measurements, we have characterized the propagation constant of the FGC waveguide, the lumped and distributed circuit elements integrated in the FGC waveguide, and the coupling between parallel transmission lines. Although the attenuation per unit length is higher for the FGC waveguide because of higher conductor loss, the attenuation is comparable when the ground plane width is twice the center conductor width as shown in the following graph. An upper limit to the line width is derived from observations that when the total line width is greater than ld/2, spurious resonances due to the parallel plate waveguide mode are established. Thus, the ground plane width must be less than ld/4 where ld is the wavelength in the dielectric. Since the center conductor width S is typically less than l/10 to maintain good transverse electromagnetic mode characteristics, it follows that a ground plane width of B = 2S would also be electrically narrow. Thus, we can now treat the ground strips of the FGC waveguide the same way that the center conductor is treated.
Derived from text
Waveguides; Planar Structures; Wireless Communication

20050189153 Air Force Research Lab., Brooks AFB, TX USA
Human Effectiveness and Risk Characterization of the Electromuscular Incapacitation Device - A Limited Analysis of the TASER. Part 2. Appendices
Maier, Andrew; Nance, Patricia; Price, Paul; Sherry, Clifford J.; Reilly, J. P.; Mar. 2005; 31 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434298; No Copyright; Avail: CASI; A03, Hardcopy

Non-Lethal Weapons (NLWs) are becoming increasingly important assets in nontraditional military operations, such as peacekeeping missions or humanitarian aid operations, where the use of lethal force may not be a desired first response for force protection. NLWs are weapons that ‘are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment’ (DoD, 1996). Various types of weapons are part of the Department of Defense (DoD) non-lethal weapons program, employing riot control agents, electromagnetic, mechanical, or acoustic technologies. DoD directive 3000.3 calls for these weapons to ‘achieve an appropriate balance between the competing goals of having a low probability of causing death, permanent injury, and collateral materiel damage, and a high probability of having the desired anti-personnel or anti-materiel effects: (DoD, 1996). In an effort to achieve this balance the Joint Non-Lethal Weapons Human Effects Center of Excellence (JNLW HECOE) requested that Toxicology Excellence for Risk Assessment (TERA) organize a workshop of leading risk assessment experts, who were joined by Subject Matter Experts (SMEs) from the DoD and its contractors, to develop a framework for characterizing the risks from military use of NLWs. The results of risk characterization are to provide decision-makers with the probability of intended target response effects and unintended effects so that the risk could be weighed against the effectiveness and benefits of using NLWs. The TASER International Database (TI data) was provided by TASER International in July 2003. The TI data consists of 3,459 records submitted by individuals in the U.S. and Canada. The TI data includes information on a specific use of a TASER. The report includes information on the target individual, how and why the device was used, the number of shots fired, and the outcome. 7
DTIC
Muscles; Physiological Effects; Risk

20050189233 Consumer Product Safety Commission, Bethesda, MD, USA
Hazard Screening Report: Personal Use Items (Product Codes 1602-1623, 1625-1634, 1637-1671, 1677-1687)
Mar. 2005; 24 pp.; In English
Report No.(s): PB2005-107234; No Copyright; Avail: CASI; A03, Hardcopy

This report provides overall injury and death figures associated with Personal Use Items. The first information presented is a summary of the injury, death and cost data for the entire class of products. A trend graphic is presented which shows the frequency of estimated emergency room-treated injuries since 1997. This is followed by a chart showing the distribution of the injuries for this class of products by energy source of the hazard, i.e., mechanical, fire, electrical, chemical, or other. There is also a summary table, which shows the injuries, deaths, and costs associated with each product group. This overview is one

of a series of hazard screening reports. Each report provides information in a similar format to allow product and hazard comparison, both within and among the reports.
NTIS
Consumers; Hazards; Protection

20050192064 Bureau of Reclamation, Denver, CO, USA
Powerline (120 V A-C) Transient Suppressors
Cascino, G. M.; Aug. 1982; 30 pp.; In English
Report No.(s): PB2005-106515; GR-81-13; No Copyright; Avail: CASI; A03, Hardcopy

The MCG Model 710 a-c Power Line Protector is tested for the ability to suppress high-voltage transients and filter out RFI (radio frequency interference) noise on the 120-volt a-c power line. Several other commercially built transient suppressors were also tested and the results compared.
NTIS
Alternating Current; Lightning; Power Lines; Protection; Protectors; Suppressors; Surges

20050192243 NASA Glenn Research Center, Cleveland, OH, USA
Soft-Fault Detection Technologies Developed for Electrical Power Systems
Button, Robert M.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Glenn Research Center, partner universities, and defense contractors are working to develop intelligent power management and distribution (PMAD) technologies for future spacecraft and launch vehicles. The goals are to provide higher performance (efficiency, transient response, and stability), higher fault tolerance, and higher reliability through the application of digital control and communication technologies. It is also expected that these technologies will eventually reduce the design, development, manufacturing, and integration costs for large, electrical power systems for space vehicles. The main focus of this research has been to incorporate digital control, communications, and intelligent algorithms into power electronic devices such as direct-current to direct-current (dc-dc) converters and protective switchgear. These technologies, in turn, will enable revolutionary changes in the way electrical power systems are designed, developed, configured, and integrated in aerospace vehicles and satellites. Initial successes in integrating modern, digital controllers have proven that transient response performance can be improved using advanced nonlinear control algorithms. One technology being developed includes the detection of ‘soft faults,’ those not typically covered by current systems in use today. Soft faults include arcing faults, corona discharge faults, and undetected leakage currents. Using digital control and advanced signal analysis algorithms, we have shown that it is possible to reliably detect arcing faults in high-voltage dc power distribution systems (see the preceding photograph). Another research effort has shown that low-level leakage faults and cable degradation can be detected by analyzing power system parameters over time. This additional fault detection capability will result in higher reliability for long-lived power systems such as reusable launch vehicles and space exploration missions.
Author
Spacecraft Electronic Equipment; Electrical Faults; Fault Detection

20050192246 NASA Glenn Research Center, Cleveland, OH, USA
Advanced Electrical Materials and Components Being Developed
Schwarze, Gene E.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

All aerospace systems require power management and distribution (PMAD) between the energy and power source and the loads. The PMAD subsystem can be broadly described as the conditioning and control of unregulated power from the energy source and its transmission to a power bus for distribution to the intended loads. All power and control circuits for PMAD require electrical components for switching, energy storage, voltage-to-current transformation, filtering, regulation, protection, and isolation. Advanced electrical materials and component development technology is a key technology to increasing the power density, efficiency, reliability, and operating temperature of the PMAD. The primary means to develop advanced electrical components is to develop new and/or significantly improved electronic materials for capacitors, magnetic components, and semiconductor switches and diodes. The next important step is to develop the processing techniques to fabricate electrical and electronic components that exceed the specifications of presently available state-of-the-art components. The NASA Glenn Research Center’s advanced electrical materials and component development technology task is focused on the following three areas: 1) New and/or improved dielectric materials for the development of power capacitors with increased capacitance volumetric efficiency, energy density, and operating temperature; 2) New and/or improved high-frequency, high-temperature soft magnetic materials for the development of transformers and inductors with increased power density,

energy density, electrical efficiency, and operating temperature; 3) Packaged high-temperature, high-power density, high-voltage, and low-loss SiC diodes and switches.
Author
Dielectrics; Magnetic Materials; Silicon Carbides

20050192272 NASA Glenn Research Center, Cleveland, OH, USA
Thermionic Emission of Single-Wall Carbon Nanotubes Measured
Landis, Geoffrey A.; Krainsky, Isay L.; Bailey, Sheila G.; Elich, Jeffrey M.; Landi, Brian J.; Gennett, Thomas; Raffaelle, Ryne P.; Research and Technology 2003; May 2004; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Researchers at the NASA Glenn Research Center, in collaboration with the Rochester Institute of Technology, have investigated the thermionic properties of high-purity, single-wall carbon nanotubes (SWNTs) for use as electron-emitting electrodes. Carbon nanotubes are a recently discovered material made from carbon atoms bonded into nanometer-scale hollow tubes. Such nanotubes have remarkable properties. An extremely high aspect ratio, as well as unique mechanical and electronic properties, make single-wall nanotubes ideal for use in a vast array of applications. Carbon nanotubes typically have diameters on the order of 1 to 2 nm. As a result, the ends have a small radius of curvature. It is these characteristics, therefore, that indicate they might be excellent potential candidates for both thermionic and field emission.
Derived from text
Thermionic Emission; Carbon Nanotubes; Nanotubes

20050192311 NASA Glenn Research Center, Cleveland, OH, USA
Stirling Cooler Designed for Venus Exploration
Landis, Geoffrey A.; Mellott, Kenneth D.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Venus having an average surface temperature of 460 degrees Celsius (about 860 degrees Fahrenheit) and an atmosphere 150 times denser than the Earth's atmosphere, designing a robot to merely survive on the surface to do planetary exploration is an extremely difficult task. This temperature is hundreds of degrees higher than the maximum operating temperature of currently existing microcontrollers, electronic devices, and circuit boards. To meet the challenge of Venus exploration, researchers at the NASA Glenn Research Center studied methods to keep a pressurized electronics package cooled, so that the operating temperature within the electronics enclosure would be cool enough for electronics to run, to allow a mission to operate on the surface of Venus for extended periods.
Derived from text
Venus Surface; Space Exploration; Electronic Packaging

20050192326 NASA Glenn Research Center, Cleveland, OH, USA
Prototype Lithium-Ion Battery Developed for Mars 2001 Lander
Manzo, Michelle A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In fiscal year 1997, NASA, the Jet Propulsion Laboratory, and the U.S. Air Force established a joint program to competitively develop high-power, rechargeable lithium-ion battery technology for aerospace applications. The goal was to address Department of Defense and NASA requirements not met by commercial battery developments. Under this program, contracts have been awarded to Yardney Technical Products, Eagle- Picher Technologies, LLC, BlueStar Advanced Technology Corporation, and SAFT America, Inc., to develop cylindrical and prismatic cell and battery systems for a variety of NASA and U.S. Air Force applications. The battery systems being developed range from low-capacity (7 to 20 A-hr) and low-voltage (14 to 28 V) systems for planetary landers and rovers to systems for aircraft that require up to 270 V and for Unmanned Aerial Vehicles that require capacities up to 200 A-hr. Low-Earth-orbit and geosynchronousorbit spacecraft pose additional challenges to system operation with long cycle life (\g30,000 cycles) and long calendar life (\g10 years), respectively.
Derived from text
Defense Program; Lithium Batteries; Mars Surveyor 2001 Mission

20050192351 NASA Glenn Research Center, Cleveland, OH, USA
Electronics Demonstrated for Low- Temperature Operation
Patterson, Richard L.; Hammond, Ahmad; Gerber, Scott S.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The operation of electronic systems at cryogenic temperatures is anticipated for many NASA spacecraft, such as planetary explorers and deep space probes. For example, an unheated interplanetary probe launched to explore the rings of Saturn would experience an average temperature near Saturn of about 183 C. Electronics capable of low-temperature operation in the harsh deep space environment also would help improve circuit performance, increase system efficiency, and reduce payload development and launch costs. An ongoing research and development program on low-temperature electronics at the NASA Glenn Research Center at Lewis Field is focusing on the design of efficient power systems that can survive and exploit the advantages of low-temperature environments. The targeted systems, which are mission driven, include converters, inverters, controls, digital circuits, and special-purpose circuits. Initial development efforts successfully demonstrated the low-temperature operation and cold-restart of several direct-current/direct-current (dc/dc) converters based on different types of circuit design, some with superconducting inductors. The table lists some of these dc/dc converters with their properties, and the photograph shows a high-voltage, high-power dc/dc converter designed for an ion propulsion system for low-temperature operation. The development efforts of advanced electronic systems and the supporting technologies for low-temperature operation are being carried out in-house and through collaboration with other Government agencies, industry, and academia. The Low Temperature Electronics Program supports missions and development programs at NASA s Jet Propulsion Laboratory and Goddard Space Flight Center. The developed technologies will be transferred to commercial end users for applications such as satellite infrared sensors and medical diagnostic equipment.
Author
Aerospace Environments; Cryogenic Temperature; Superconductivity; Digital Electronics; Low Temperature; Deep Space

20050192365 FDE, Inc., USA, NASA Glenn Research Center, Cleveland, OH, USA
Modular Low-Heater-Power Cathode/Electron Gun Assembly for Microwave and Millimeter Wave Traveling Wave Tubes
Wintucky, Edwin G.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A low-cost, low-mass, electrically efficient, modular cathode/electron gun assembly has been developed by FDE Inc. of Beaverton, Oregon, under a Small Business Innovation Research (SBIR) contract with the NASA Glenn Research Center at Lewis Field. This new assembly offers significant improvements in the design and manufacture of microwave and millimeter wave traveling-wave tubes (TWT's) used for radar and communications. It incorporates a novel, low-heater-power, reduced size and mass, high-performance barium dispenser type thermionic cathode and provides for easy integration of the cathode into a large variety of conventional TWT circuits. Among the applications are TWT's for Earth-orbiting communication satellites and for deep space communications, where future missions will require smaller spacecraft, higher data transfer rates (higher frequencies and radiofrequency output power), and greater electrical efficiency. A particularly important TWT application is in the microwave power module (a hybrid microwave/millimeter wave amplifier consisting of a low-noise solid-state driver, a small TWT, and an electronic power conditioner integrated into a single compact package), where electrical efficiency and thermal loading are critical factors and lower cost is needed for successful commercialization. The design and fabrication are based on practices used in producing cathode ray tubes (CRT's), which is one of the most competitive and efficient manufacturing operations in the world today. The approach used in the design and manufacture of thermionic cathodes and electron guns for CRT's has been optimized for fully automated production, standardization of parts, and minimization of costs. It is applicable to the production of similar components for microwave tubes, with the additional benefits of low mass and significantly lower cathode heater power (less than half that of dispenser cathodes presently used in TWT s). Modular cathode/electron gun assembly. The modular cathode/electron gun assembly consists of four subassemblies the cathode, the focus electrode, the header (including the electrical feedthroughs), and the gun envelope (including the anode) a diagram of which is shown. The modular construction offers a number of significant advantages, including flexibility of design, interchangeability of parts, and a drop-in final assembly procedure for quick and accurate alignment. The gun can accommodate cathodes ranging in size from 0.050 to 0.250-in. in diameter and is applicable to TWT's over a broad range of sizes and operating parameters, requiring the substitution of only a few parts: that is, the cathode, focus electrode, and anode. The die-pressed cathode pellets can be made with either flat or concave (Pierce gun design) emitting surfaces. The gun can be either gridded (pulse operation) or ungridded (continuous operation). Important factors contributing to low cost are the greater use of CRT materials and parts, the standardization of processes (welding and mechanical capture), and tooling amenable to automated production. Examples are the use of simple shapes, drawn or stamped metal parts, and parts joined by welding or mechanical capture. Feasibility was successfully demonstrated in the retrofit and testing of a commercial Kaband (22-GHz) TWT. The modular cathode/electron gun assembly was computer modeled to replicate the performance of the original electron gun and fabricated largely from existing CRT parts. Significant test results included demonstration of low heater power (1.5-W, 1010 C brightness temperature for a 0.085-in.-diameter cathode), mechanical ruggedness (100g shock

and vibration tests in accordance with military specifications (MIL specs)), and a very fast warmup. The results of these tests indicate that the low-cost CRT manufacturing approach can be used without sacrificing performance and reliability.
Author
Cathodes; Electron Guns; Heaters; Millimeter Waves; Traveling Wave Tubes; Microwaves; Fabrication

20050192367 NASA Glenn Research Center, Cleveland, OH, USA
Digital Channel Simulator Developed and Tested
Bizon, Thomas P.; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Digital Channel Simulator (DCS) is a real-time test set developed in-house by the NASA Glenn Research Center at Lewis Field that simulates the characteristics of the modulator, demodulator, and transmission medium in a typical communications system to enable controlled laboratory testing of codec pairs. The DCS can support data rates up to 100 megasymbols per second (Msymbols/sec) with symbol sizes up to 10 bits and is compatible with both TTL (transistor transistor logic) and ECL (emitter coupled logic) interfaces. Because of its use of digital integrated circuits (IC's), the DCS offers the user accurate and repeatable testing while maintaining a simple reconfiguration of the modulation scheme and noise characteristics. The PC-based graphical user interface (GUI) assures user friendly operation for configuring, controlling, and monitoring the DCS and system during tests. In a typical communications system, the modulator places a symbol in constellation space and puts it on a carrier to be sent to the demodulator. Because of noise on the channel, the I and Q position in constellation space cannot be recovered exactly, and the received coordinates shift. To mimic this process in the laboratory, the DCS uses a mapper to place the symbol in constellation space. It simulates the shift in coordinates by digitally adding 'noise' to the I and Q values. The mapper and noise source are implemented in lookup tables. Modulation schemes and noise characteristics are set by the values loaded in these tables. The mapper also has a pass-through mode to facilitate modulator testing, allowing noise to be added to 8-bit I and Q values of modulated data without a second mapping. To achieve high symbol rates, eight processing circuits are placed in parallel between an ECL demultiplexer and multiplexer. A graphical user interface was developed to calculate, load, and verify the values for the lookup tables. This interface can also be used to debug and verify proper operation of the channel simulator or to control an experiment. Operation of the DCS has been verified through three tests: a low-speed comprehensive system test, a high-speed (20 Msymbols/sec) test of the TTL interface, and a high-speed (100 Msymbols/sec) test of the ECL interface. The DCS is now ready for use by NASA and external customers.
Author
Digital Electronics; Integrated Circuits; Simulators; Channels (Data Transmission)

20050192399 Sest, Inc., OH, USA
Development of Electronic Load Controllers for Free-Piston Stirling Convertors Aided by Stirling Simulation Model
Regan, Timothy F.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The free-piston Stirling convertor end-to-end modeling effort at the NASA Glenn Research Center has produced a software-based test bed in which free-piston Stirling convertors can be simulated and evaluated. The simulation model includes all the components of the convertor: the Stirling cycle engine, heat source, linear alternator, controller, and load. So far, it has been used in evaluating the performance of electronic controller designs. Three different controller design concepts were simulated using the model: 1) Controllers with parasitic direct current loading. 2) Controllers with parasitic alternating current loading. 3) Controllers that maintain a reference current. The free-piston Stirling convertor is an electromechanical device that operates at resonance. It is the function of the electronic load controller to ensure that the electrical load seen by the machine is always great enough to keep the amplitude of the piston and alternator oscillation at the rated value. This is done by regulating the load on the output bus. The controller monitors the instantaneous voltage, regulating it by switching loads called parasitic loads onto the bus whenever the bus voltage is too high and removing them whenever the voltage is too low. In the first type of controller, the monitor-ing and switching are done on the direct-current (dc) bus. In the second type, the alternating current bus is used. The model allows designers to test a controller concept before investing time in hardware. The simulation code used to develop the model also offers detailed models of digital and analog electronic components so that the resulting designs are realistic enough to translate directly into hardware circuits.
Author
Controllers; Simulation; Stirling Cycle; Electromechanical Devices; Loads (Forces); Models; Power Converters

20050192400 NASA Glenn Research Center, Cleveland, OH, USA
Temperature Distribution Within a Defect-Free Silicon Carbide Diode Predicted by a Computational Model
Kuczmarski, Maria A.; Neudeck, Philip G.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Most solid-state electronic devices diodes, transistors, and integrated circuits are based on silicon. Although this material works well for many applications, its properties limit its ability to function under extreme high-temperature or high-power operating conditions. Silicon carbide (SiC), with its desirable physical properties, could someday replace silicon for these types of applications. A major roadblock to realizing this potential is the quality of SiC material that can currently be produced. Semiconductors require very uniform, high-quality material, and commercially available SiC tends to suffer from defects in the crystalline structure that have largely been eliminated in silicon. In some power circuits, these defects can focus energy into an extremely small area, leading to overheating that can damage the device. In an effort to better understand the way that these defects affect the electrical performance and reliability of an SiC device in a power circuit, the NASA Glenn Research Center at Lewis Field began an in-house three-dimensional computational modeling effort. The goal is to predict the temperature distributions within a SiC diode structure subjected to the various transient overvoltage breakdown stresses that occur in power management circuits. A commercial computational fluid dynamics computer program (FLUENT-Fluent, Inc., Lebanon, New Hampshire) was used to build a model of a defect-free SiC diode and generate a computational mesh. A typical breakdown power density was applied over 0.5 msec in a heated layer at the junction between the p-type SiC and n-type SiC, and the temperature distribution throughout the diode was then calculated. The peak temperature extracted from the computational model agreed well (within 6 percent) with previous first-order calculations of the maximum expected temperature at the end of the breakdown pulse. This level of agreement is excellent for a model of this type and indicates that three-dimensional computational modeling can provide useful predictions for this class of problem. The model is now being extended to include the effects of crystal defects. The model will provide unique insights into how high the temperature rises in the vicinity of the defects in a diode at various power densities and pulse durations. This information also will help researchers in understanding and designing SiC devices for safe and reliable operation in high-power circuits.
Author
Temperature Distribution; Silicon Carbides; Integrated Circuits; Solid State Devices; Transistors; Performance Tests; Computational Fluid Dynamics

20050192408 NASA Glenn Research Center, Cleveland, OH, USA
Deep Etching Process Developed for the Fabrication of Silicon Carbide Microsystems
Beheim, Glenn M.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Silicon carbide (SiC), because of its superior electrical and mechanical properties at elevated temperatures, is a nearly ideal material for the microminiature sensors and actuators that are used in harsh environments where temperatures may reach 600 C or greater. Deep etching using plasma methods is one of the key processes used to fabricate silicon microsystems for more benign environments, but SiC has proven to be a more difficult material to etch, and etch depths in SiC have been limited to several micrometers. Recently, the Sensors and Electronics Technology Branch at the NASA Glenn Research Center at Lewis Field developed a plasma etching process that was shown to be capable of etching SiC to a depth of 60 mm. Deep etching of SiC is achieved by inductive coupling of radiofrequency electrical energy to a sulfur hexafluoride (SF6) plasma to direct a high flux of energetic ions and reactive fluorine atoms to the SiC surface. The plasma etch is performed at a low pressure, 5 mtorr, which together with a high gas throughput, provides for rapid removal of the gaseous etch products. The lateral topology of the SiC microstructure is defined by a thin film of etch-resistant material, such as indium-tin-oxide, which is patterned using conventional photolithographic processes. Ions from the plasma bombard the exposed SiC surfaces and supply the energy needed to initiate a reaction between SiC and atomic fluorine. In the absence of ion bombardment, no reaction occurs, so surfaces perpendicular to the wafer surface (the etch sidewalls) are etched slowly, yielding the desired vertical sidewalls.
Author
Etching; Silicon Carbides; Microstructure; Sulfur Hexafluoride; Plasma Etching; Actuators; Microminiaturization; Electrical Properties

20050192410 NASA Glenn Research Center, Cleveland, OH, USA
Packaging Technology Developed for High-Temperature SiC Sensors and Electronics
Chen, Liang-Yu; Hunter, Gary W.; Neudeck, Philip G.; Lei, Jih-Fen; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A ceramic- and thick-film-materials-based prototype electronic package designed for silicon carbide (SiC) high-temperature sensors and electronics has been successfully tested at 500 C in an oxygen-containing air environment for 500 hours. This package was designed, fabricated, assembled, and electronically evaluated at the NASA Glenn Research Center at Lewis Field with an in-house-fabricated SiC semiconductor test chip. High-temperature electronics and sensors are

necessary for harsh-environment space and aeronautical applications, such as space missions to the inner solar system or the emission control electronics and sensors in aeronautical engines. Single-crystal SiC has such excellent physical and chemical material properties that SiC-based semiconductor electronics can operate at temperatures over 600 C, which is significantly higher than the limit for Si-based semiconductor devices. SiC semiconductor chips were recently demonstrated to be operable at temperatures as high as 600 C, but only in the probe station environment because suitable packaging technology for sensors and electronics at temperatures of 500 C and beyond did not exist. Thus, packaging technology for SiC-based sensors and electronics is immediately needed for both application and commercialization of high-temperature SiC sensors and electronics. In response to this need, researchers at Glenn designed, fabricated, and assembled a prototype electronic package for high-temperature electronics, sensors, and microelectromechanical systems (MEMS) using aluminum nitride (AlN) substrate and gold (Au) thick-film materials. This prototype package successfully survived a soak test at 500 C in air for 500 hours. Packaging components tested included thick-film high-temperature metallization, internal wire bonds, external lead bonds, and a SiC diode chip die-attachment. Each test loop, which was composed of thick-film printed wire, wire bond, and lead bond was subjected to a 50-mA direct current for 250 hours at 500 C.
Author
High Temperature; Silicon Carbides; Semiconductor Devices; Microelectromechanical Systems; Metallizing; Direct Current

20050192430 National Taiwan Univ. of Science and Technology, Taipei, Taiwan, Province of China
Journal of the Chinese Institute of Engineers, Volume 28, No. 3
Chen, Shi-Sheuenn, Editor; Tsai, Hsien-Lung, Editor; Shiou, Fang-Jung, Editor; Chao, Hui-Yu, Editor; Lee, Liang-Sun, Editor; Young, Der-Liang, Editor; Pan, Ching-Tsai, Editor; Chen, Jean-Lien, Editor; Chung, Chung-Ping, Editor; Chao, Ching-Kong, Editor, et al.; May 2005; ISSN 0253-3839; 174 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail: Other Sources

Contents include the following: A statistical model with hierarchical structure for predicting prosody in a mandarin text-to-speech system. Measurements and modeling of wave propagation over irregular terrain for signals in the vhf band. New minimum error rate algorithms for DFE. Design of a class of extended dynamic linear controller via LMI approach. A novel closed-loop reconfiguration for radial distribution systems with dispersed generation. A design for an adjustable fuzzy pulse pump controller in a frequency-locked servo system. Fuzzy a statistical model with hierarchical structure for predicting prosody in a covariance control for a class of continuous perturbed nonlinear stochastic systems. Fuzzy covariance control for a class of continuous perturbed nonlinear stochastic systems. application of genetic algorithm to the observer-based controller design for neutral systems. Distillation synthesis separation sequence optimization based on application of adaptive parallel tabu search. Effect of inorganic salts on the inhibition of hydrolyzing halo-ester in a two-phase solution. Compartmentalizing anaerobic zone improves sludge settling property of enhanced biological phosphorus removal system under low sludge retention time. A fast IP lookup scheme for high speed routers. An anonymous buyer-reseller watermarking protocol.
CASI
Distillation; Feedback Control; Genetic Algorithms; Mathematical Models; Wave Propagation

34
FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

20050186901 NASA Glenn Research Center, Cleveland, OH, USA
Parametric Investigation of Liquid Jets in Low Gravity
Chato, David J.; June 2005; 25 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA
Contract(s)/Grant(s): 22-614-50-04-11
Report No.(s): NASA/TM-2005-213639; AIAA Paper 2003-0997; E-15123; No Copyright; Avail: CASI; A03, Hardcopy

An axisymmetric phase field model is developed and used to model surface tension forces on liquid jets in microgravity. The previous work in this area is reviewed and a baseline drop tower experiment selected for model comparison. This paper uses the model to parametrically investigate the influence of key parameters on the geysers formed by jets in microgravity. Investigation of the contact angle showed the expected trend of increasing contact angle increasing geyser height. Investigation of the tank radius showed some interesting effects and demonstrated the zone of free surface deformation is quite

large. Variation of the surface tension with a laminar jet showed clearly the evolution of free surface shape with Weber number. It predicted a breakthrough Weber number of 1.
Author
Jet Flow; Microgravity; Laminar Flow; Fluid Jets; Interfacial Tension; Surface Properties

20050186904 NASA Glenn Research Center, Cleveland, OH, USA
Collection Efficiency and Ice Accretion Characteristics of Two Full Scale and One 1/4 Scale Business Jet Horizontal Tails
Bidwell, Colin S.; Papadakis, Michael; June 2005; 38 pp.; In English; SAE General Aviation Technology Conference and Exposition, 9-11 May 2000, Wichita, KS, USA
Contract(s)/Grant(s): WBS 22-077-41-08
Report No.(s): NASA/TM-2005-213653; SAE-2000-01-1683; E-15142; No Copyright; Avail: CASI; A03, Hardcopy

Collection efficiency and ice accretion calculations have been made for a series of business jet horizontal tail configurations using a three-dimensional panel code, an adaptive grid code, and the NASA Glenn LEWICE3D grid based ice accretion code. The horizontal tail models included two full scale wing tips and a 25 percent scale model. Flow solutions for the horizontal tails were generated using the PMARC panel code. Grids used in the ice accretion calculations were generated using the adaptive grid code ICEGRID. The LEWICE3D grid based ice accretion program was used to calculate impingement efficiency and ice shapes. Ice shapes typifying rime and mixed icing conditions were generated for a 30 minute hold condition. All calculations were performed on an SGI Octane computer. The results have been compared to experimental flow and impingement data. In general, the calculated flow and collection efficiencies compared well with experiment, and the ice shapes appeared representative of the rime and mixed icing conditions for which they were calculated.
Author
Horizontal Tail Surfaces; Scale Models; Full Scale Tests; Aircraft Icing; Computational Fluid Dynamics; Wind Tunnel Tests; Jet Aircraft

20050187006 NASA Lewis Research Center, Cleveland, OH, USA
Thermal Mechanical Stability of Single-Crystal-Oxide Refractive Concentrators Evaluated for High-Temperature Solar-Thermal Propulsion
Jacobson, Nathan S.; Jacobson, Nathan S.; Miller, Robert A.; Research and Technology 1998; August 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Recently, refractive secondary solar concentrator systems were developed for solar thermal power and propulsion (ref. 1). Single-crystal oxides-such as yttria-stabilized zirconia (Y2O3-ZrO2), yttrium aluminum garnet (Y3Al5O12, or YAG), magnesium oxide (MgO), and sapphire (Al2O3)-are candidate refractive secondary concentrator materials. However, the refractive concentrator system will experience high-temperature thermal cycling in the solar thermal engine during the sun/shade transition of a space mission. The thermal mechanical reliability of these components in severe thermal environments is of great concern. Simulated mission tests are important for evaluating these candidate oxide materials under a variety of transient and steady-state heat flux conditions. In this research at the NASA Lewis Research Center, a controlled heat flux test approach was developed for investigating the thermal mechanical stability of the candidate oxide. This approach used a 3.0-kW continuous-wave (wavelength, 10.6 mm) carbon dioxide (CO2) laser (ref. 2). The CO2 laser is especially well-suited for single-crystal thermal shock tests because it can directly deliver well-characterized heat energy to the oxide surfaces. Since the oxides are opaque at the 10.6-mm wavelength of the laser beam, the light energy is absorbed at the surfaces rather than transmitting into the crystals, and thus generates the required temperature gradients within the specimens. The following figure is a schematic diagram of the test rig.
Author
Thermal Stability; Single Crystals; Oxides; Refractivity; Concentrators; Solar Thermal Propulsion; High Temperature

20050187025 Portland State Univ., OR, USA
Capillary Driven Flows Along Differentially Wetted Interior Corners
Golliher, Eric L., Technical Monitor; Nardin, C. L.; Weislogel, M. M.; June 2005; 31 pp.; In English
Contract(s)/Grant(s): NAS3-00126; NAG3-2741; WBS 22-101-53-01
Report No.(s): NASA/CR-2005-213799; E-15157; No Copyright; Avail: CASI; A03, Hardcopy

Closed-form analytic solutions useful for the design of capillary flows in a variety of containers possessing interior corners were recently collected and reviewed. Low-g drop tower and aircraft experiments performed at NASA to date show

excellent agreement between theory and experiment for perfectly wetting fluids. The analytical expressions are general in terms of contact angle, but do not account for variations in contact angle between the various surfaces within the system. Such conditions may be desirable for capillary containment or to compute the behavior of capillary corner flows in containers consisting of different materials with widely varying wetting characteristics. A simple coordinate rotation is employed to recast the governing system of equations for flows in containers with interior corners with differing contact angles on the faces of the corner. The result is that a large number of capillary driven corner flows may be predicted with only slightly modified geometric functions dependent on corner angle and the two (or more) contact angles of the system. A numerical solution is employed to verify the new problem formulation. The benchmarked computations support the use of the existing theoretical approach to geometries with variable wettability. Simple experiments to confirm the theoretical findings are recommended. Favorable agreement between such experiments and the present theory may argue well for the extension of the analytic results to predict fluid performance in future large length scale capillary fluid systems for spacecraft as well as for small scale capillary systems on Earth.
Author
Capillary Flow; Corners; Microgravity; Wetting; Fluid Dynamics

20050187093 Johns Hopkins Univ., Baltimore, MD, USA
Numerical and Physical Modelling of Bubbly Flow Phenomena. Final Report, July 1, 1989-January 1, 1999
Prosperetti, A.; January 2005; 14 pp.; In English
Report No.(s): DE2005-835303; No Copyright; Avail: Department of Energy Information Bridge

This report describes the main features of the results obtained in the course of this project. A new approach to the systematic development of closure relations for the averaged equations of disperse multiphase flow is outlined. The focus of the project is on spatially non-uniform systems and several aspects in which such systems differ from uniform ones are described. Then, the procedure used in deriving the closure relations is given and some explicit results shown. The report also contains a list of publications supported by this grant and a list of the persons involved in the work.
NTIS
Bubbles; Mathematical Models; Multiphase Flow; Two Phase Flow

20050187097 Carnegie-Mellon Univ., Pittsburgh, PA USA
Melt Fracture Revisited
Greenberg, J. M.; January 2005; 22 pp.; In English
Report No.(s): DE2005-821220; No Copyright; Avail: Department of Energy Information Bridge

In a previous paper the author and Demay advanced a model to explain the melt fracture instability observed when molten linear polymer melts are extruded in a capillary rheometer operating under the controlled condition that the inlet flow rate was held constant. The model postulated that the melts were a slightly compressible viscous fluid and allowed for slipping of the melt at the wall. The novel feature of that model was the use of an empirical switch law which governed the amount of wall slip. The model successfully accounted for the oscillatory behavior of the exit flow rate, typically referred to as the melt fracture instability, but did not simultaneously yield the fine scale spatial oscillations in the melt typically referred to as shark skin. In this note a new model is advanced which simultaneously explains the melt fracture instability and shark skin phenomena. The model postulates that the polymer is a slightly compressible linearly viscous fluid but assumes no slip boundary conditions at the capillary wall. In simple shear the shear stress T and strain rate d are assumed to be related by d = FT where F ranges between F2 and F1 greater than F2. A strain rate dependent yield function is introduced and this function governs whether F evolves towards F2 or F1. This model accounts for the empirical observation that at high shears polymers align and slide more easily than at low shears and explains both the melt fracture and shark skin phenomena.
NTIS
Fracture Mechanics; Fracturing; Mathematical Models; Rheology

20050188502 NASA Lewis Research Center, Cleveland, OH, USA
Multistage Turbomachinery Flows Simulated Numerically
Hathaway, Michael D.; Adamczyk, John J.; Shabbir, Aamir; Wellborn, Steven R.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

At the NASA Lewis Research Center, a comprehensive assessment was made of the predictive capability of the average passage flow model as applied to multistage axial-flow compressors. This model, which describes the time-averaged flow field within a typical passage of a blade row embedded in a multistage configuration, is being widely used throughout U.S. aircraft

industry as an integral part of their design systems. Rotor flow-angle deviation. In this work, detailed data taken within a four and one-half stage large low-speed compressor were used to assess the weaknesses and strengths of the predictive capabilities of the average passage flow model. The low-speed compressor blading is of modern design and employs stator end-bends. Measurements were made with slow- and high response instrumentation. The high-response measurements revealed the velocity components of both the rotor and stator wakes. From the measured wake profiles, we found that the flow exiting the rotors deviated from the rotor exit metal angle to a lesser degree than was predicted by the average passage flow model. This was found to be due to blade boundary layer transition, which recently has been shown to exist on multistage axial compressor rotor and stator blades, but was not accounted for in the average passage model. Consequently, a model that mimics the effects of blade boundary layer transition, Shih k-epsilon model, was incorporated into the average passage model. Simulations that incorporated this transition model showed a dramatic improvement in agreement with data. The altered model thus improved predictive capability for multistage axial-flow compressors, and this was verified by detailed experimental measurement. Author

Simulation; Numerical Analysis; Rotor Blades (Turbomachinery); Axial Flow; Turbocompressors

20050188504 NASA Lewis Research Center, Cleveland, OH, USA

Optical Flow-Field Techniques Used for Measurements in High-Speed Centrifugal Compressors

Skoch, Gary J.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The overall performance of a centrifugal compressor depends on the performance of the impeller and diffuser as well as on the interactions occurring between these components. Accurate measurements of the flow fields in each component are needed to develop computational models that can be used in compressor design codes. These measurements must be made simultaneously over an area that covers both components so that researchers can understand the interactions occurring between the two components. Optical measurement techniques are being used at the NASA Lewis Research Center to measure the velocity fields present in both the impeller and diffuser of a 4:1 pressure ratio centrifugal compressor operating at several conditions ranging from design flow to surge. Laser Doppler Velocimetry (LDV) was used to measure the intrablade flows present in the impeller, and the results were compared with analyses obtained from two three-dimensional viscous codes. The development of a region of low throughflow velocity fluid within this high-speed impeller was examined and compared with a similar region first observed in a large low-speed centrifugal impeller at Lewis. Particle Image Velocimetry (PIV) is a relatively new technique that has been applied to measuring the diffuser flow fields. PIV can collect data rapidly in the diffuser while avoiding the light-reflection problems that are often encountered when LDV is used. The Particle Image Velocimeter employs a sheet of pulsed laser light that is introduced into the diffuser in a quasi-radial direction through an optical probe inserted near the diffuser discharge. The light sheet is positioned such that its centerline is parallel to the hub and shroud surfaces and such that it is parallel to the diffuser vane, thereby avoiding reflections from the solid surfaces. Seed particles small enough to follow the diffuser flow are introduced into the compressor at an upstream location. A high-speed charge-coupled discharge (CCD) camera is synchronized to the laser pulse rate; this allows it to capture images of seed particle position that are separated by a small increment in time. A crosscorrelation of a particle's position in two consecutive images provides an estimate of flow velocity and direction. Multiple image pairs obtained in rapid succession at a particular flow condition provide enough measurements for statistical significance. PIV provides simultaneous velocity measurements over the entire plane that is illuminated by the light sheet instead of at a single point, as is the case when LDV is used. PIV has a further advantage in that the laser light pulse can be triggered by an external source such as a high-response pressure transducer. This feature will allow PIV to synchronize flow imaging to physical phenomena such as rotating stall or stall precursor waves. We hope that this technique can be used to obtain images of the flow field during and just prior to stall. Author

Centrifugal Compressors; Flow Distribution; High Pressure; Optical Measurement

20050188507 NASA Lewis Research Center, Cleveland, OH, USA

LeRC-HT: NASA Lewis Research Center General Multiblock Navier-Stokes Heat Transfer Code Developed

Heidmann, James D.; Gaugler, Raymond E.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

For the last several years, LeRC-HT, a three-dimensional computational fluid dynamics (CFD) computer code for analyzing gas turbine flow and convective heat transfer, has been evolving at the NASA Lewis Research Center. The code is unique in its ability to give a highly detailed representation of the flow field very close to solid surfaces. This is necessary for an accurate representation of fluid heat transfer and viscous shear stresses. The code has been used extensively for both internal cooling passage flows and hot gas path flows--including detailed film cooling calculations, complex tip-clearance gap flows, and heat transfer. In its current form, this code has a multiblock grid capability and has been validated for a number of turbine

configurations. The code has been developed and used primarily as a research tool (at least 35 technical papers have been published relative to the code and its application), but it should be useful for detailed design analysis. We now plan to make this code available to selected users for further evaluation.
Author
Computational Fluid Dynamics; Multiblock Grids; Navier-Stokes Equation; Three Dimensional Flow; Convective Heat Transfer

20050188524 NASA Lewis Research Center, Cleveland, OH, USA
Combustion Instabilities Modeled
Paxson, Daniel E.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Lewis Research Center's Advanced Controls and Dynamics Technology Branch is investigating active control strategies to mitigate or eliminate the combustion instabilities prevalent in lean-burning, low-emission combustors. These instabilities result from coupling between the heat-release mechanisms of the burning process and the acoustic flow field of the combustor. Control design and implementation require a simulation capability that is both fast and accurate. It must capture the essential physics of the system, yet be as simple as possible. A quasi-one-dimensional, computational fluid dynamics (CFD) based simulation has been developed which may meet these requirements. The Euler equations of mass, momentum, and energy have been used, along with a single reactive species transport equation to simulate coupled thermoacoustic oscillations. A very simple numerical integration scheme was chosen to reduce computing time. Robust boundary condition procedures were incorporated to simulate various flow conditions (e.g., valves, open ends, and choked inflow) as well as to accommodate flow reversals that may arise during large flow-field oscillations. The accompanying figure shows a sample simulation result. A combustor with an open inlet, a choked outlet, and a large constriction approximately two thirds of the way down the length is shown. The middle plot shows normalized, time-averaged distributions of the relevant flow quantities, and the bottom plot illustrates the acoustic mode shape of the resulting thermoacoustic oscillation. For this simulation, the limit cycle peak-to-peak pressure fluctuations were 13 percent of the mean. The simulation used 100 numerical cells. The total normalized simulation time was 50 units (approximately 15 oscillations), which took 26 sec on a Sun Ultra2.
Derived from text
Combustion Chambers; Flow Stability; Computerized Simulation; Combustion Physics

20050188541 NASA Lewis Research Center, Cleveland, OH, USA
Multidisciplinary Probabilistic Heat Transfer/Structural Analysis Code Developed: NESTEM
Murthy, Pappu L. N.; Pai, Shantaram S.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

High-Speed Civil Transport (HSCT) engine combustor liners are subjected to complex thermal environments and have to endure these for thousands of hours with assured reliability. In the past, several deterministic analyses have been performed, including detailed heat transfer analyses to obtain thermal profiles and deterministic stress analyses to identify critical locations of high stresses. Actual rig tests also have been performed for segments by simulating these loading situations as closely as possible. However, it is well known that many uncertainties exist in loading (primarily thermal loads due to heat transfer), boundary conditions (end fixity unknowns), and material properties (moduli, thermal-expansion coefficients, and conductivities). The present in-house effort at the NASA Lewis Research Center is directed toward accounting for these in a formal way to assess the performance of liner components under complex and uncertain loading conditions as well as subject to other geometry- and material-related uncertainties.
Derived from text
Heat Transfer; Linings; Structural Analysis

20050188550 NASA Lewis Research Center, Cleveland, OH, USA
WIND Flow Solver Released
Towne, Charles E.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The WIND code is a general-purpose, structured, multizone, compressible flow solver that can be used to analyze steady or unsteady flow for a wide range of geometric configurations and over a wide range of flow conditions. WIND is the latest product of the NPARC Alliance, a formal partnership between the NASA Lewis Research Center and the Air Force Arnold Engineering Development Center (AEDC). WIND Version 1.0 was released in February 1998, and Version 2.0 will be released in February 1999. The WIND code represents a merger of the capabilities of three existing computational fluid dynamics codes--NPARC (the original NPARC Alliance flow solver), NXAIR (an Air Force code used primarily for unsteady store

separation problems), and NASTD (the primary flow solver at McDonnell Douglas, now part of Boeing).
Derived from text
Computational Fluid Dynamics; Applications Programs (Computers)

20050189164 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Structures of Angled Aerated-Liquid Jets in March 1.94 Supersonic Crossflow
Dixon, Dion R.; Mar. 2005; 82 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434438; AFIT/GAE/ENY/05-M07; No Copyright; Avail: Defense Technical Information Center (DTIC)

The structures of aerated-liquid jets injected into a supersonic crossflow have been studied experimentally. Aerated-liquid injectors with diameters of 0. 020', 0.040' and 0.060' were flush mounted on the bottom plate of a supersonic wind tunnel to provide normal and angled injection. Free stream Mach number and temperature were held constant at 1.94 and 500 degrees F, respectively. Water at room temperature was used as the liquid injectant and nitrogen gas used as the aerating gas. Wide ranges of test conditions for injection angle (circle minus), injector orifice diameter (d0), jet-to-air momentum flux ratios (q0), and gas-to-liquid ratios (GLR), were studied. Injection angles were varied from 45 downstream to 90 (normal to freestream). Jet-to-air momentum flux was varied from 1% to 15% of the free stream and gas-to-liquid ratios from 0% (pure-liquid injection) to 10%. Shadowgraph and laser sheet illumination techniques were used for spray visualization while a phase Doppler Particle Analyzer (PDPA) was utilized to quantitatively measure droplet and spray plume properties. The data from all three methods were used to develop correlations for the droplet and spray plume properties for aerated-liquid jets using a linear fit of the base-10 logarithm coefficients. Correlations relating penetration height and spray plume width of the injected spray to the above listed parameters, as well as the normalized axial distance downstream of the injector, x/d0, were formulated based on all three measurement techniques. Results indicate that a reasonable prediction of penetration height, spray plume cross sectional area, and local equivalence ratio can be obtained from PDPA data, while other visualization techniques tend to under-predict such quantities.
DTIC
Aeration; Cross Flow; Fluid Jets; Mach Number; Supersonic Combustion; Supersonic Flow

20050189198 NASA Lewis Research Center, Cleveland, OH, USA
Results of Liquid Motion Experiment Analyzed
Chato, David J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

About half of all scientific and commercial spacecraft spin during some part of their mission. Although spinning has many benefits (increasing stability, controlling the location of liquid propellants, and distributing solar heat loads), it also creates problems because a precession (or wobble) motion is unavoidable. For modern spacecraft, by far the largest source of wobble is energy dissipation in the liquid of partially filled tanks. The liquid s energy dissipation cannot, however, be quantified adequately by any ground test. Current analytical models are also inadequate because fundamental data on fluid motion in low gravity are needed to validate them. Consequently, spacecraft attitude-control systems are designed and operated very conservatively. Nonetheless, spacecraft often still perform poorly in orbit, and some have been lost because of a rapid increase of the wobble rate. The Liquid Motion Experiment (LME) was designed to provide spacecraft designers accurate data on the wobble dynamics of spacecraft that contain large quantities of mobile liquids. LME, which was flown on the space shuttle mission STS-84, was built under contract to the NASA Lewis Research Center by the Southwest Research Institute of San Antonio, Texas. Major accomplishments for 1998 include reduction of the flight data and publication of the experimental results. LME was essentially a spin table that created a realistic nutation motion of scale-model tanks containing liquid. Two spherical and two cylindrical transparent tanks were tested simultaneously, and three sets of such tanks were employed to vary liquid viscosity, fill level, and propellant management device (PMD) design. All the tanks were approximately 4.5 in. in diameter. The primary test measurements were the radial and tangential torques exerted on the tanks by the liquid. These torques could not be measured on the ground because of the masking effects of gravity.
Author
Spaceborne Experiments; Fluid Dynamics; Liquid Sloshing; Spin Tests

20050189264 Clarkson Coll. of Technology, Potsdam, NY, USA
Bubble Motion, Deformation, and Breakup, 2000-2003, $199,899
Mar. 08, 2004; 22 pp.; In English
Report No.(s): DE2005-823827; No Copyright; Avail: Department of Energy Information Bridge

The last three projects considered various aspects of the behavior of bubbles in high Reynolds number flows. One

common theme of these studies has been on the effects of surfactants on bubble motion.
NTIS
Bubbles; Deformation

20050192103 NASA Lewis Research Center, Cleveland, OH, USA
Time-Shifted Boundary Conditions Used for Navier-Stokes Aeroelastic Solver
Srivastava, Rakesh; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Under the Advanced Subsonic Technology (AST) Program, an aeroelastic analysis code (TURBO-AE) based on Navier-Stokes equations is currently under development at NASA Lewis Research Center s Machine Dynamics Branch. For a blade row, aeroelastic instability can occur in any of the possible interblade phase angles (IBPA s). Analyzing small IBPA s is very computationally expensive because a large number of blade passages must be simulated. To reduce the computational cost of these analyses, we used time shifted, or phase-lagged, boundary conditions in the TURBO-AE code. These conditions can be used to reduce the computational domain to a single blade passage by requiring the boundary conditions across the passage to be lagged depending on the IBPA being analyzed. The time-shifted boundary conditions currently implemented are based on the direct-store method. This method requires large amounts of data to be stored over a period of the oscillation cycle. On CRAY computers this is not a major problem because solid-state devices can be used for fast input and output to read and write the data onto a disk instead of storing it in core memory.
Derived from text
Aeroelasticity; Boundary Conditions; Navier-Stokes Equation; Flow Measurement

20050192138 NASA Lewis Research Center, Cleveland, OH, USA
Microgravity Experiments Being Developed for Microscopic Study of Colloidal Spheres
Rogers, Richard B.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Microscopic spheres suspended in liquid become highly ordered under the proper conditions. Such collections of particles, called colloidal suspensions or colloids, are the subject of a series of ongoing microgravity experiments at the NASA Lewis Research Center. By studying the way these colloidal suspensions order themselves, scientists can better understand how atoms of a liquid become ordered to form a solid. In addition, highly ordered colloids have special properties that may make them useful in future hightech applications. Work is underway at Lewis to develop an optical microscope to view these colloidal suspensions sphere by sphere in microgravity.
Derived from text
Microgravity; Colloids; Spheres

20050192149 NASA Lewis Research Center, Cleveland, OH, USA
Onset of Convection Due to Surface Tension Variations in Multicomponent and Binary Fluid Layers
Skarda, J. Raymond Lee; Research and Technology 1998; April 1999; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Under certain conditions, such as in thin liquid films or microgravity, surface tension variations along a free surface can induce convection. Convection onset due to surface tension variation is important to many terrestrial technological processes in addition to microgravity materials processing applications. Examples include coating, drying crystallization, solidification, liquid surface contamination, and containerless processing. In double-diffusive and multicomponent systems, the spatial variations of surface tension are associated with two or more stratifying agencies, respectively. For example, both temperature and species (concentration) gradients are associated with convection in the solidification of binary alloys or salt ponds. The direction of the two (or more) gradients has a profound effect on the nature of the flow at or slightly beyond the onset of convection. Our recent work at the NASA Lewis Research Center focused on characterizing surface-tension-induced onset of convection, often referred to as Marangoni-Benard convection. Exact solutions for the stationary neutral stability of multicomponent fluid layers with interfacial deformation were derived. These solutions also permit the computation of a boundary curve that separates the long and finite wavelength instabilities. Computing points along this boundary using the exact solution (when possible) is more efficient than the typical numerical approaches, such as finite difference or spectral methods. Above the curve, a long wavelength instability was predicted, suggesting that convection would occur principally through one large flow cell in the layer, whereas below the curve, finite wavelength instabilities occur which suggest multiple finite-sized circulation cells. For many common liquids with layer depths greater than 100 mm, finite wave instability is

predicted under terrestrial conditions; however, with little exception, long wavelength instability is predicted in microgravity for the identical fluid systems.
Derived from text
Interfacial Tension; Marangoni Convection; Binary Fluids

20050192277 NASA Glenn Research Center, Cleveland, OH, USA
Thermal Conductivity Change Kinetics of Ceramic Thermal Barrier Coatings Determined by the Steady-State Laser Heat Flux Technique
Zhu, Dongming; Miller, Robert A.; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A steady-state laser heat flux technique has been developed at the NASA Glenn Research Center at Lewis Field to obtain critical thermal conductivity data of ceramic thermal barrier coatings under the temperature and thermal gradients that are realistically expected to be encountered in advanced engine systems. In this study, thermal conductivity change kinetics of a plasma-sprayed, 254-mm-thick ZrO2-8 wt % Y2O3 ceramic coating were obtained at high temperatures. During the testing, the temperature gradients across the coating system were carefully measured by the surface and back pyrometers and an embedded miniature thermocouple in the substrate. The actual heat flux passing through the coating system was determined from the metal substrate temperature drop (measured by the embedded miniature thermocouple and the back pyrometer) combined with one-dimensional heat transfer models.
Derived from text
Thermal Conductivity; Thermal Control Coatings; Laser Applications; Heat Flux; Ceramic Coatings

20050192379 NASA Glenn Research Center, Cleveland, OH, USA
Inlet Unstart Propulsion Integration Wind Tunnel Test Program Completed for High-Speed Civil Transport
Porro, A. Robert; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

One of the propulsion system concepts to be considered for the High-Speed Civil Transport (HSCT) is an underwing, dual-propulsion, pod-per-wing installation. Adverse transient phenomena such as engine compressor stall and inlet unstart could severely degrade the performance of one of these propulsion pods. The subsequent loss of thrust and increased drag could cause aircraft stability and control problems that could lead to a catastrophic accident if countermeasures are not in place to anticipate and control these detrimental transient events. Aircraft system engineers must understand what happens during an engine compressor stall and inlet unstart so that they can design effective control systems to avoid and/or alleviate the effects of a propulsion pod engine compressor stall and inlet unstart. The objective of the Inlet Unstart Propulsion Airframe Integration test program was to assess the underwing flow field of a High-Speed Civil Transport propulsion system during an engine compressor stall and subsequent inlet unstart. Experimental research testing was conducted in the 10- by 10-Foot Supersonic Wind Tunnel at the NASA Glenn Research Center at Lewis Field. The representative propulsion pod consisted of a two-dimensional, bifurcated inlet mated to a live turbojet engine. The propulsion pod was mounted below a large flat plate that acted as a wing simulator. Because of the plate s long length (nominally 10-ft wide by 18-ft long), realistic boundary layers could form at the inlet cowl plane. Transient instrumentation was used to document the aerodynamic flow-field conditions during an unstart sequence. Acquiring these data was a significant technical challenge because a typical unstart sequence disrupts the local flow field for about only 50 msec. Flow surface information was acquired via static pressure taps installed in the wing simulator, and intrusive pressure probes were used to acquire flow-field information. These data were extensively analyzed to determine the impact of the unstart transient on the surrounding flow field. This wind tunnel test program was a success, and for the first time, researchers acquired flow-field aerodynamic data during a supersonic propulsion system engine compressor stall and inlet unstart sequence. In addition to obtaining flow-field pressure data, Glenn researchers determined other properties such as the transient flow angle and Mach number. Data are still being reduced, and a comprehensive final report will be released during calendar year 2000.
Author
Engine Inlets; Wind Tunnel Tests; Civil Aviation; Propulsion System Configurations; Supersonic Wind Tunnels; Engine Airframe Integration

20050192380 NASA Glenn Research Center, Cleveland, OH, USA, Arnold Engineering Development Center, Arnold AFS, TN, USA, Boeing Phantom Works, USA
CFD Software for Aerospace Applications Available From the NPARC Alliance
Towne, Charles E.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NPARC (National Program for Application-Oriented Research in CFD) Alliance is a formal partnership between the NASA Glenn Research Center at Lewis Field and the Air Force Arnold Engineering Development Center, with additional significant involvement by the Boeing Company's Phantom Works Group, whose mission is to provide an applications-oriented computational fluid dynamics (CFD) system primarily for aerospace flow simulation. The Alliance is committed to the long-range maintenance and improvement of this capability, with teams focused on user support, code development, and validation. The principal product of the NPARC Alliance is the WIND code, a general-purpose, structured, multizone, compressible flow solver that can be used to analyze steady or unsteady flow for a wide range of geometric configurations and over a wide range of flow conditions. WIND can be run in serial mode on a variety of platforms, including personal computers, or in a fault-tolerant parallel-processing mode on a heterogeneous network of Unix workstations. Version 2.0 of WIND was released in April 1999. In addition to the WIND code itself, a variety of preprocessing and postprocessing tools are included for setting boundary conditions, examining computed results, and other functions. The Alliance maintains extensive World Wide Web sites that contain code documentation and validation data. The documentation includes user manuals that describe the operation and use of the WIND code and its associated utilities, and developer reference material for those who are interested in modifying or extending the code. The validation site contains detailed examples showing the use of WIND for a variety of flows and geometries. It serves as an archive of analytical, experimental, and computational data suitable for CFD code validation. The NPARC Alliance is continuing to expand and improve the software, with current efforts focused on enhancing WIND's chemistry capability, adding unstructured and hybrid grid technology, and developing a global code framework for multidisciplinary analyses. All NPARC Alliance software is available without charge to U.S.-owned companies, public and private universities, and government agencies (for use by U.S. citizens and resident aliens). Instructions for obtaining the code may be obtained from the NPARC Alliance home page, or from the NPARC Alliance User Support team. Since its initial release in February 1998, the WIND code has been acquired by over 130 different organizations.
Author
Computational Fluid Dynamics; Software Engineering; Aerospace Engineering; Computer Programs; Applications Programs (Computers)

20050192382 NASA Glenn Research Center, Cleveland, OH, USA
DRAGON Grid: A Three-Dimensional Hybrid Grid Generation Code Developed
Liou, Meng-Sing; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Because grid generation can consume 70 percent of the total analysis time for a typical three-dimensional viscous flow simulation for a practical engineering device, payoffs from research and development could reduce costs and increase throughputs considerably. In this study, researchers at the NASA Glenn Research Center at Lewis Field developed a new hybrid grid approach with the advantages of flexibility, high-quality grids suitable for an accurate resolution of viscous regions, and a low memory requirement. These advantages will, in turn, reduce analysis time and increase accuracy. They result from an innovative combination of structured and unstructured grids to represent the geometry and the computation domain. The present approach makes use of the respective strengths of both the structured and unstructured grid methods, while minimizing their weaknesses. First, the Chimera grid generates high-quality, mostly orthogonal meshes around individual components. This process is flexible and can be done easily. Normally, these individual grids are required overlap each other so that the solution on one grid can communicate with another. However, when this communication is carried out via a nonconservative interpolation procedure, a spurious solution can result. Current research is aimed at entirely eliminating this undesired interpolation by directly replacing arbitrary grid overlapping with a nonstructured grid called a DRAGON grid, which uses the same set of conservation laws over the entire region, thus ensuring conservation everywhere. The DRAGON grid is shown for a typical film-cooled turbine vane with 33 holes and 3 plenum compartments. There are structured grids around each geometrical entity and unstructured grids connecting them. In fiscal year 1999, Glenn researchers developed and tested the three-dimensional DRAGON grid-generation tools. A flow solver suitable for the DRAGON grid has been developed, and a series of validation tests are underway.
Author (revised)
Grid Generation (Mathematics); Three Dimensional Flow; Computer Programs; Turbine Engines

20050192405 NASA Glenn Research Center, Cleveland, OH, USA
Thin-Film Ceramic Thermocouples Fabricated and Tested
Wrbanek, John D.; Fralick, Gustave C.; Farmer, Serene C.; Sayir, Ali; Gregory, Otto J.; Blaha, Charles A.; Research and Technology 2003; May 2004; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Sensors and Electronics Technology Branch of the NASA Glenn Research Center is developing thin-film-based

sensors for surface measurement in propulsion system research. Thin-film sensors do not require special machining of the components on which they are mounted, and they are considerably thinner than wire- or foil-based sensors. One type of sensor being advanced is the thin-film thermocouple, specifically for applications in high-temperature combustion environments. Ceramics are being demonstrated as having the potential to meet the demands of thin-film thermocouples in advanced aerospace environments. The maximum-use temperature of noble metal thin-film thermocouples, 1500 C (2700 F), may not be adequate for components used in the increasingly harsh conditions of advanced aircraft and next-generation launch vehicles. Ceramic-based thermocouples are known for their high stability and robustness at temperatures exceeding 1500 C, but are typically in the form of bulky rods or probes. As part of ASTP, Glenn's Sensors and Electronics Technology Branch is leading an in-house effort to apply ceramics as thin-film thermocouples for extremely high-temperature applications as part of ASTP. Since the purity of the ceramics is crucial for the stability of the thermocouples, Glenn's Ceramics Branch and Case Western Reserve University are developing high-purity ceramic sputtering targets for fabricating high-temperature sensors. Glenn's Microsystems Fabrication Laboratory, supported by the Akima Corporation, is using these targets to fabricate thermocouple samples for testing. The first of the materials used were chromium silicide (CrSi) and tantalum carbide (TaC). These refractory materials are expected to survive temperatures in excess of 1500 C. Preliminary results indicate that the thermoelectric voltage output of a thin-film CrSi versus TaC thermocouple is 15 times that of the standard type R (platinum-rhodium versus platinum) thermocouple, producing 20 mV with a 200 C temperature gradient. The photograph on the left shows the CrSi-TaC thermocouple in a test fixture at Glenn, and the resulting output signal is shown on the right. The temperature differential across the sample, from the center of the sample inside the oven to the sample mount outside the oven, is measured using a type R thermocouple on the sample.

Author

Ceramics; Thin Films; Thermocouples; Electric Potential; High Temperature Environments; Thermoelectricity; Temperature Gradients; Noble Metals

20050192433 NASA Langley Research Center, Hampton, VA, USA

Aeroelastic Response and Protection of Space Shuttle External Tank Cable Trays

Edwards, John W.; Keller, Donald F.; Schuster, David M.; Piatak, David J.; Rausch, Russ D.; Bartels, Robert E.; Ivanco, Thomas G.; Cole, Stanley R.; Spain, Charles V.; [2005]; 17 pp.; In English; 41st AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 10-13 Jul. 2005, Tucson, AZ, USA

Report No.(s): AIAA Paper 2005-3627; No Copyright; Avail: CASI; A03, Hardcopy

Sections of the Space Shuttle External Tank Liquid Oxygen (LO2) and Liquid Hydrogen (LH2) cable trays are shielded from potentially damaging airloads with foam Protuberance Aerodynamic Load (PAL) Ramps. Flight standard design LO2 and LH2 cable tray sections were tested with and without PAL Ramp models in the USA Air Force Arnold Engineering Development Center s (AEDC) 16T transonic wind tunnel to obtain experimental data on the aeroelastic stability and response characteristics of the trays and as part of the larger effort to determine whether the PAL ramps can be safely modified or removed. Computational Fluid Dynamic simulations of the full-stack shuttle launch configuration were used to investigate the flow characeristics around and under the cable trays without the protective PAL ramps and to define maximum crossflow Mach numbers and dynamic pressures experienced during launch. These crossflow conditions were used to establish wind tunnel test conditions which also included conservative margins. For all of the conditions and configurations tested, no aeroelastic instabilities or unacceptable dynamic response levels were encountered and no visible structural damage was experienced by any of the tested cable tray sections. Based upon this aeroelastic characterization test, three potentially acceptable alternatives are available for the LO2 cable tray PAL Ramps: Mini-Ramps, Tray Fences, or No Ramps. All configurations were tested to maximum conditions, except the LH2 trays at -15 deg. crossflow angle. This exception is the only caveat preventing the proposal of acceptable alternative configurations for the LH2 trays as well. Structural assessment of all tray loads and tray response measurements from launches following the Shuttle Return To Flight with the existing PAL Ramps will determine the acceptability of these PAL Ramp alternatives.

Author

Aeroelasticity; External Tanks; Space Shuttles; Wind Tunnel Tests; Cables; Computational Fluid Dynamics

20050192463 NASA Langley Research Center, Hampton, VA, USA

Numerical Investigation of Flow in an Over-Expanded Nozzle with Porous Surfaces

Elmiligui, Alaa; Abdol-Hamid, K. S.; Hunter, Craig A.; [2005]; 19 pp.; In English; 41st AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 10-13 Jul. 2005, Tucson, AZ, USA

Contract(s)/Grant(s): 23-781-10-12

Report No.(s): AIAA Paper 2005-4159; Copyright; Avail: CASI; A03, Hardcopy

A new porous condition has been implemented in the PAB3D solver for simulating the flow over porous surfaces. The newly-added boundary condition is utilized to compute the flow field of a non-axisymmetric, convergent-divergent nozzle incorporating porous cavities for shock-boundary layer interaction control. The nozzle has an expansion ratio (exit area/throat area) of 1.797 and a design nozzle pressure ratio of 8.78. The flow fields for a baseline nozzle (no porosity) and for a nozzle with porous surfaces (10% porosity ratio) are computed for NPR varying from 2.01 to 9.54. Computational model results indicate that the over-expanded nozzle flow was dominated by shock-induced boundary-layer separation. Porous configurations were capable of controlling off-design separation in the nozzle by encouraging stable separation of the exhaust flow. Computational simulation results, wall centerline pressure, mach contours, and thrust efficiency ratio are presented and discussed. Computed results are in excellent agreement with experimental data.
Author
Flow Distribution; Nozzle Flow; Porosity; Computer Programs; Nozzle Geometry; Porous Boundary Layer Control

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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 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

20050186928 National Inst. of Information and Communications Technology, Tokyo, Japan
Study for Far-infrared and Faint Light Detection Technology
Fujiwara, Mikio; Sasaki, Masahide; Akiba, Makoto; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 51-58; In English; See also 20050186915; Copyright; Avail: Other Sources

To realize a sensitive photodetector, cooling down the device is a effective way because of reducing thermal noise and dark current. Recent space observation satellites have liquid-helium cooled detectors. We focus on far-infrared region, in which there are many important research fields. To our knowledge, we are the first to successfully report a direct hybrid two-dimensional detector array in the far-infrared region. Moreover, we are trying to develop an ultra-sensitive photodetector for the application in quantum information field by using cryogenic technology.
Author
Infrared Detectors; Far Infrared Radiation

20050186932 National Inst. of Information and Communications Technology, Japan
Image Storage Techniques using Photorefractive Effect
Takayama, Yoshihisa; Zhang, Jiasen; Okazaki, Yumi; Kodate, Kashiko; Aruga, Tadashi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 119-124; In English; See also 20050186915; Copyright; Avail: Other Sources

Optical image storage techniques using the photorefractive effect are presented. In these techniques, the random reference multiplexing scheme is introduced to the holographic recording process in order to increase the storage capacity. The common feature of our techniques is the use of a bundle of multimode fibers placed in the optical path of reference wave. This approach can automatically impose quasi-random patterns on the wavefront when the. reference wave penetrates the fiber bundle. As a proof-of-principle, experiments of recording holograms are performed with a LiNbO3 crystal. The results show that the use of fiber bundle enables us to build a simple and compact optical setup keeping the capacity of hologram multiplexing.
Author
Imaging Techniques; Photorefractivity; Holography; Multiplexing

20050188496 NASA Lewis Research Center, Cleveland, OH, USA
Scanning Mode Shock Position Sensor Invented and Demonstrated
Adamovsky, Grigory; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A flow-visualizing system with a scanning optical beam offers greater advantages than the conventional approaches. In addition to a higher signal-to-noise ratio and lower source power, the scanning permits visualization of weak phenomena such as the scattering and diffraction of light on shocks. Scanning beam flow-visualization techniques were evaluated at the NASA

Lewis Research Center for shock position sensing. In an effort to eliminate moving parts, a spectral scanning technique was invented and demonstrated.
Derived from text
Flow Visualization; Optical Scanners; Position Sensing

20050189180 Florida International Univ., Miami, FL USA
Three-Dimensional Magnetic Recording Device
Khizroev, Sakhrat; Chomko, Roman; Hijazi, Yazan; Amos, Nissim; Dec. 2004; 15 pp.; In English
Contract(s)/Grant(s): FA9550-04-1-0446
Report No.(s): AD-A434257; AFRL-SR-AR-TR-05-0219; No Copyright; Avail: CASI; A03, Hardcopy

In the course of this proposal, it is proposed to develop and simulate a thermally-stable one-thousand-layer 3-D recording system with an eight-bit address/word line capable of recording and retrieving eight bits in parallel. Assuming a bit cell with one square micron in cross-section, this is equivalent to an effective areal density of 640 Gbit/in2. The undergraduate student involved in this proposal (Nissim Amos) and the PI will make a presentation of the results of the numerical simulations indicating the functionality of the device. The simulations proposed will be performed both with PC and a state-of-the-art computer cluster system recently established at FIU. The use of the cluster computing will allow to extend the simulations (in the near future) to systems capable of pentabyte recording. The simulations will incorporate both magnetostatic and micromagnetic (quantum-mechanical) interactions between the grains in the 3-D media. The thermal stability of the recording media will be addressed throughout the simulations. In the course of this proposal, it is planned to raise interest in this technology at least to the level of prototype building. A detailed plan (with drawings and steps) to build a first-principle prototype will be proposed by the end of the project. In the course of this proposal, it is planned to publish at least two articles (one on the modeling technique and the other on the simulation results) in peer-review journals (upon an agreement with US Air Force). The above-described project on simulation of a 3-D magnetic recording system will be conducted in parallel with the experimental work on the prototype development.
DTIC
Magnetic Recording; Magnetic Disks

20050192124 NASA Lewis Research Center, Cleveland, OH, USA
Stability of Enclosed Laminar Flames Studied in Microgravity
Stocker, Dennis P.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In practical combustion systems, the flame is often anchored at the inlet where the fuel is injected into an air duct. This type of system is found in powerplant combustors, gas turbine combustors, and the jet engine afterburner. Despite its successful use, this configuration is vulnerable to adverse flow conditions that can cause the flame to literally lift off from the inlet or even blowout. Poor flame stability is, of course, unwanted, especially where safety has a high priority. Our understanding of the mechanisms that control flame stability is incomplete in part because the interaction of buoyant (i.e., gravity-induced) convection makes it difficult to interpret normal-gravity results. However, a comparison of normal-gravity and microgravity results can provide a clear indication of the influence of forced and buoyant flows on flame stability. Therefore, a joint microgravity study on the stability of Enclosed Laminar Flames (ELF) was carried out by researchers at The University of Iowa and the NASA Lewis Research Center. The microgravity tests were conducted in the Microgravity Glovebox (MGBX), during the STS-87 space shuttle mission in late 1997, using hardware designed and produced at Lewis. The primary objective of the ELF investigation was to determine the mechanisms controlling the stability of round, laminar, gas-jet diffusion flames in a coflow air duct. The study specifically focused on the effect of buoyancy on the flame characteristics and velocities at the lift-off, reattachment, and blowout of the flame. When the fuel or air velocity is increased to a critical value, the flame base abruptly jumps downstream, and the flame is said to have reached its lift-off condition. Flow conditions are such that the flame cannot be maintained at the burner rim despite the presence of both fuel and oxygen. When the velocity is further increased, the flame eventually extinguishes at its blowout condition. In contrast, if the velocity is reduced, the flame base eventually returns to anchor at the burner rim, at a velocity lower than that of lift-off, indicating a hysteresis effect.
Derived from text
Test Facilities; Spaceborne Experiments; Microgravity; Combustion Physics; Flame Stability

20050192130 NASA Lewis Research Center, Cleveland, OH, USA
Phase-Shifted Laser Feedback Interferometry
Ovryn, Benjie; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Phase-shifted, laser feedback interferometry is a new diagnostic tool developed at the NASA Lewis Research Center under the Advanced Technology Development (ATD) Program directed by NASA Headquarters Microgravity Research Division. It combines the principles of phase-shifting interferometry (PSI) and laser-feedback interferometry (LFI) to produce an instrument that can quantify both optical path length changes and sample reflectivity variations. In a homogenous medium, the optical path length between two points is the product of the index of refraction and the geometric distance between the two points. LFI differs from other forms of interferometry by using the laser as both the source and the phase detector. In LFI, coherent feedback of the incident light either reflected directly from a surface or reflected after transmission through a region of interest will modulate the output intensity of the laser. The combination of PSI and LFI has produced a robust instrument, based on a low-power helium-neon (HeNe) gas laser, with a high dynamic range that can be used to measure either static or oscillatory changes of the optical path length. Small changes in optical path length are limited by the fraction of a fringe that can be measured; we can measure nonoscillatory changes with a root mean square (rms) error of the wavelength/1000 without averaging.
Author
Laser Interferometry; Phase Detectors; Phase Shift

20050192150 NASA Lewis Research Center, Cleveland, OH, USA
Space Acceleration Measurement System for Free Flyers
Kacpura, Thomas J.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Experimenters from the fluids, combustion, materials, and life science disciplines all use the microgravity environment of space to enhance their understanding of fundamental physical phenomena caused by disturbances from events such as spacecraft maneuvers, equipment operations, atmospheric drag, and (for manned flights) crew movement. Space conditions reduce gravity but do not eliminate it. To quantify the level of these disturbances, NASA developed the Space Acceleration Measurement System (SAMS) series to collect data characterizing the acceleration environment on the space shuttles. This information is provided to investigators so that they can evaluate how the microgravity environment affects their experiments. Knowledge of the microgravity environment also helps investigators to plan future experiments. The original SAMS system flew 20 missions on the shuttle as well as on the Russian space station Mir. Presently, Lewis is developing SAMS-II for the International Space Station; it will be a distributed system using digital output sensor heads. The latest operational version of SAMS, SAMS-FF, was originally designed for free flyer spacecraft and unmanned areas. SAMS-FF is a flexible, modular system, housed in a lightweight package, and it uses advances in technology to improve performance. The hardware package consists of a control and data acquisition module, three different types of sensors, data storage devices, and ground support equipment interfaces. Three different types of sensors are incorporated to measure both high- and low-frequency accelerations and the roll rate velocity. Small, low-power triaxial sensor heads (TSH's) offer high resolution and selectable bandwidth, and a special low-frequency accelerometer is available for high-resolution, low-frequency applications. A state-of-the-art, triaxial fiberoptic gyroscope that measures extremely low roll rates is housed in a compact package. The versatility of the SAMS-FF system is shown in the three different types of missions SAMS-FF has supported.
Derived from text
Acceleration Measurement; Spacecraft Equipment; Instrument Packages; Accelerometers; Gyroscopes

20050192391 NASA Glenn Research Center, Cleveland, OH, USA
Strain Measurement System Developed for Biaxially Loaded Cruciform Specimens
Krause, David L.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A new extensometer system developed at the NASA Glenn Research Center at Lewis Field measures test area strains along two orthogonal axes in flat cruciform specimens. This system incorporates standard axial contact extensometers to provide a cost-effective high-precision instrument. The device was validated for use by extensive testing of a stainless steel specimen, with specimen temperatures ranging from room temperature to 1100 F. In-plane loading conditions included several static biaxial load ratios, plus cyclic loadings of various waveform shapes, frequencies, magnitudes, and durations. The extensometer system measurements were compared with strain gauge data at room temperature and with calculated strain values for elevated-temperature measurements. All testing was performed in house in Glenn's Benchmark Test Facility in-plane biaxial load frame.
Derived from text
Strain Gages; Extensometers; Strain Measurement

36
LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

20050186918 National Inst. of Information and Communications Technology, Japan
Research on Sb-based Quantum Dot Laser
Akahane, Kouichi; Ohtani, Naoki; Yamamoto, Naokatsu; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 79-85; In English; See also 20050186915; Copyright; Avail: Other Sources

We have developed Sb-based quantum dot lasers operating at 1.3 microns fabricated on GaAs substrates. We introduce here two different methods; one is to use GaAsSb layers for reducing the stress effect on InAs quantum dots, the other is to make InGaSb quantum dots in the laser's active region. The fabricated laser diodes are successfully operating for a wavelength of 1.3 microns at room temperature.
Author
Antimony; Quantum Dots; Semiconductor Lasers

20050186927 National Inst. of Information and Communications Technology, Japan
Wind Profile Measurements by Coherent Doppler Lidar
Mizutani, Kohei; Ishii, Shoken; Aoki, Tetsuo; Sato, Atsushi; Itabe, Toshikazu; Sasano, Masahiko; Asai, Kazuhiro; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 167-176; In English; See also 20050186915; Copyright; Avail: Other Sources

Global wind profiling by a space-borne Doppler lidar with an eye-safe laser is expected to bring big progress in numerical weather prediction and the studies on global climate modeling. CRL has been conducting studies on the lasers for the space-borne coherent Doppler lidar to observe wind and aerosol profiles and developing the algorithm for the wind profiling through ground-based and airborne wind observations by a coherent Doppler lidar. We are also making studies on systems for a demonstration of the global wind profiling by the space-borne coherent Doppler lidar.
Author
Doppler Radar; Optical Radar; Wind Profiles; Coherent Radar; Spaceborne Lasers

20050189183 Naval Postgraduate School, Monterey, CA USA
Jefferson Lab Free Electron Laser 10 kW Upgrade - Lessons Learned
Williams, B. W.; May 2005; 49 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434107; NPS-PH-05-001; XB-PMS-405; No Copyright; Avail: CASI; A03, Hardcopy

The activities of the Free Electron Laser (FEL) Group at Thomas Jefferson National Accelerator Facility (JLab) in Newport News, Virginia, during the Infrared Demonstration Free Electron Laser Upgrade Project are summarized. The project spanned four years, from July 2000 to June 2004, and resulted in the upgrade from a 1 kW-class FEL to a 10 kW-class FEL at JLab. Lessons learned during the Upgrade are presented and discussed.
DTIC
Free Electron Lasers; Laser Beams

20050192142 NASA Lewis Research Center, Cleveland, OH, USA
Laser Light Scattering with Multiple Scattering Suppression Used to Measure Particle Sizes
Meyer, William V.; Tin, Padetha; Lock, James A.; Cannell, David S.; Smart, Anthony E.; Taylor, Thomas W.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Laser light scattering is the technique of choice for noninvasively sizing particles in a fluid. The members of the Advanced Technology Development (ATD) project in laser light scattering at the NASA Lewis Research Center have invented, tested, and recently enhanced a simple and elegant way to extend the concentration range of this standard laboratory particle-sizing technique by several orders of magnitude. With this technique, particles from 3 nm to 3 mm can be measured in a solution. Recently, laser light scattering evolved to successfully size particles in both clear solutions and concentrated milky-white solutions. The enhanced technique uses the property of light that causes it to form tall interference patterns at right angles to the scattering plane (perpendicular to the laser beam) when it is scattered from a narrow laser beam. Such multiple-scattered light forms a broad fuzzy halo around the focused beam, which, in turn, forms short interference patterns. By placing two fiber

optics on top of each other and perpendicular to the laser beam (see the drawing), and then cross-correlating the signals they produce, only the tall interference patterns formed by singly scattered light are detected. To restate this, unless the two fiber optics see the same interference pattern, the scattered light is not incorporated into the signal. With this technique, only singly scattered light is seen (multiple-scattered light is rejected) because only singly scattered light has an interference pattern tall enough to span both of the fiber-optic pickups. This technique is simple to use, easy to align, and works at any angle. Placing a vertical slit in front of the signal collection fibers enhanced this approach. The slit serves as an optical mask, and it significantly shortens the time needed to collect good data by selectively masking out much of the unwanted light before cross-correlation is applied.
Derived from text
Laser Applications; Light Scattering; Particle Size Distribution

37
MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

20050186907 Akron Univ., Akron, OH, USA
Extending the capabilities of compare to include material damage
Saleeb, Atef F.; Wilt, Thomas E.; Vakada, Krishna C.; April 2005; 2 pp.; In English
Contract(s)/Grant(s): NCC3-992; No Copyright; Avail: CASI; A01, Hardcopy
No abstract available
Damage; Mechanical Properties; Fatigue (Materials)

20050186908 Akron Univ., Akron, OH, USA
Emerging Sealing Technologies Development
[2005]; 3 pp.; In English
Contract(s)/Grant(s): NNC04AAl8A; No Copyright; Avail: CASI; A01, Hardcopy
Under this Cooperative Agreement, the objective was to investigate several emerging sealing technologies of interest to the Mechanical Components Branch of National Aeronautics and Space Administration Glenn Research Center at Lewis Field (NASA GRC). The majority of the work conducted was to support the development of Solid Oxide Fuel Cells for application to aeronautic auxiliary power units, though technical investigations of interest to other groups and projects were also conducted. In general, accomplishments and results were periodically reported to the NASA Technical Monitor, the NASA GRC Seal Team staff, and NASA GRC project management. Several technical reports, journal articles, and presentations were given internally to NASA GRC and to the external public.
Derived from text
NASA Programs; Sealing; Technology Utilization

20050187018 NASA Lewis Research Center, Cleveland, OH, USA
Advanced Refrigerator/Freezer Technology Development Project
Cairelli, James E.; Geng, Steven M.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy
The Advanced Refrigerator/Freezer (R/F) Technology Development Project was initiated in 1994, on the basis of recommendations of a team of NASA Scientists and engineers, who assessed the need for advanced technology to support future life and biomedical sciences space flight missions. The project, which was cofunded by NASA's Office of Aerospace Technology and Life and Biomedical Sciences & Applications Division, has two phases. In the Phase I Advanced R/F Technology Assessment, candidate technologies were identified and ranked, on the basis of a combination of their effect on system performance and their risk of developmental success. In Phase II Technology Development, the advanced technologies with the highest combined ranking, which could be accomplished within the budgetary constraints, were pursued. The effort has been mainly by contract, with a modest in-house effort at the NASA Lewis Research Center. Oceaneering Space Systems (OSS) of Houston, Texas, was selected as the prime contractor for both contract phases.
Author
Refrigerators; Freezing; Product Development; Spacecraft Equipment

20050192062 Colorado State Univ., Fort Collins, CO, USA

Fundamental Studies of Ignition Processes in Large Natural Gas Engines Using Laser Spark Ignition. First Quarterly Report, October 1, 2004-December 31, 2004

Yalin, A.; Defoort, M.; Willson, B.; Jan. 2005; 20 pp.; In English

Report No.(s): DE2005-838122; No Copyright; Avail: Department of Energy Information Bridge

The current report details project progress made during the first quarterly reporting period of the DOE sponsored project ''Fundamental studies of ignition processes in large natural gas engines using laser spark ignition''. The goal of the overall research effort is to develop a laser ignition system for natural gas engines, with a particular focus on using fiber optic delivery methods. In this report we present our successful demonstration of spark formation using fiber delivery made possible though the use of novel coated hollow fibers. We present results of (high power) experimental characterizations of light propagation using hollow fibers using both a high power research grade laser as well as a more compact laser. Finally, we present initial designs of the system we are developing for future on-engine testing using the hollow fibers.

NTIS

Engine Design; Ignition; Ignition Systems; Lasers; Natural Gas; Spark Ignition

20050192116 NASA Lewis Research Center, Cleveland, OH, USA

Metrology Evaluation of Superfinished Gears Completed

Krantz, Timothy L.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Gears, bearings, and similar mechanical elements transmit loads through the surfaces that are in contact with one another. Thus, the fatigue lives of gears can be improved by providing smoother tooth surfaces. At the NASA Lewis Research Center, we completed a metrology evaluation of one method for making gears with a highly polished, mirrorlike surface. The polished gears were measured carefully. The measurement data showed that the polishing process did, indeed, reduce the surface roughness but did not change the overall tooth shape in any harmful way. This work was done as a partnership of NASA, the U.S. Army, and the University of Wales. NASA provided conventionally ground gear specimens and has begun testing to determine the fatigue lives of the superfinished gears. Under contract, the University of Wales superfinished the gears and inspected them before and after the superfinishing operation. The U.S. Army European Research Office provided the funds and procured the contract with the University of Wales.

Derived from text

Gears; Metrology; Mechanical Properties

20050192248 NASA Glenn Research Center, Cleveland, OH, USA

Flywheel Single-Axis Integrated Momentum and Power Control System Demonstrated

Soeder, James F.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

On July 10, 2003, the NASA Glenn Research Center flywheel team experimentally demonstrated a two-flywheel-module system that simultaneously provided attitude control in a single axis and regulated power. The test was conducted using the D1 flywheel module and the high-speed shaft (HSS) in the High Energy Flywheel Facility (HEFF). Both of these flywheel modules consist of a magnetically levitated rotor with an integral motor/generator, a vacuum housing, and mechanical touchdown bearings. Energy is stored kinetically in the rotor. The motor/generator allows energy to be added to or withdrawn from the rotor, and magnetic bearings and a vacuum enclosure are used to minimize losses.

Author

Flywheels; Energy Storage; Voltage Regulators; Attitude Control

20050192257 NASA Glenn Research Center, Cleveland, OH, USA

Depth-Penetrating Measurements Developed for Thermal Barrier Coatings Incorporating Thermographic Phosphors

Eldridge, Jeffrey I.; Bencic, Timothy J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The insulating properties of thermal barrier coatings (TBCs) provide highly beneficial thermal protection to turbine engine components by reducing the temperature sustained by those components. Therefore, measuring the temperature beneath the TBC is critical for determining whether the TBC is performing its insulating function. Currently, noncontact temperature measurements are performed by infrared pyrometry, which unfortunately measures the TBC surface temperature rather than the temperature of the underlying component. To remedy this problem, the NASA Glenn Research Center, under the Information Rich Test Instrumentation Project, developed a technique to measure the temperature beneath the TBC by

incorporating a thin phosphor layer beneath the TBC. By performing fluorescence decay-time measurements on light emission from this phosphor layer, Glenn successfully measured temperatures from the phosphor layer up to 1100 C. This is the first successful demonstration of temperature measurements that penetrate beneath the TBC. Thermographic phosphors have a history of providing noncontact surface temperature measurements. Conventionally, a thermographic phosphor is applied to the material surface and temperature measurements are performed by exciting the phosphor with ultraviolet light and then measuring the temperature-dependent decay time of the phosphor emission at a longer wavelength. The innovative feature of the new approach is to take advantage of the relative transparency of the TBC (composed of yttria-stabilized zirconia) in order to excite and measure the phosphor emission beneath the TBC. The primary obstacle to achieving depth-penetrating temperature measurements is that the TBCs are completely opaque to the ultraviolet light usually employed to excite the phosphor. The strategy that Glenn pursued was to select a thermographic phosphor that could be excited and emit at wavelengths that could be transmitted through the TBC. The phosphor that was selected was yttria doped with europia (Y2O3:Eu), which has a minor excitation peak at 532 nm (green) and an emission peak at 611 nm (red)--both are wavelengths that exhibit significant transmission through the TBC. The measurements were performed on specimens consisting of a 25- m-thick phosphor layer beneath a 100- m-thick TBC. The 532-nm (green) excitation light was provided by a frequency-doubled YAG:Nd (yttrium-aluminum-garnet:neodymium) laser, and the fluorescence decay time measurements were acquired with a modified Raman microscope. The preceding graph compares the intensity of the phosphor emission of the phosphor layer above the TBC versus that of the phosphor layer beneath the TBC. Although there was considerable attenuation of the phosphor signal (a factor of 30), the phosphor emission at the reduced intensity was more than sufficient to perform fluorescence decay time measurements. The following graph shows the fluorescence lifetime temperature dependency for the Y2O3:Eu phosphor layers both above and below the TBC. These curves show an excellent match and indicate that, despite the attenuation due to the overlying TBC, the phosphor layer beneath the TBC still functions as an effective temperature indicator.

Author

Depth Measurement; Phosphors; Temperature Measurement; Thermal Control Coatings; Thermography

20050192258 NASA Glenn Research Center, Cleveland, OH, USA

New Effective Material Couple--Oxide Ceramic and Carbon Nanotube-- Developed for Aerospace Microsystem and Micromachine Technologies

Miyoshi, Kazuhisa; VanderWal, Randall L.; Tomasek, Aaron J.; Sayir, Ali; Farmer, Serene C.; Research and Technology 2003; May 2004; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The prime driving force for using microsystem and micromachine technologies in transport vehicles, such as spacecraft, aircraft, and automobiles, is to reduce the weight, power consumption, and volume of components and systems to lower costs and increase affordability and reliability. However, a number of specific issues need to be addressed with respect to using microsystems and micromachines in aerospace applications--such as the lack of understanding of material characteristics; methods for producing and testing the materials in small batches; the limited proven durability and lifetime of current microcomponents, packaging, and interconnections; a cultural change with respect to system designs; and the use of embedded software, which will require new product assurance guidelines. In regards to material characteristics, there are significant adhesion, friction, and wear issues in using microdevices. Because these issues are directly related to surface phenomena, they cannot be scaled down linearly and they become increasingly important as the devices become smaller. When microsystems have contacting surfaces in relative motion, the adhesion and friction affect performance, energy consumption, wear damage, maintenance, lifetime and catastrophic failure, and reliability. Ceramics, for the most part, do not have inherently good friction and wear properties. For example, coefficients of friction in excess of 0.7 have been reported for ceramics and ceramic composite materials. Under Alternate Fuels Foundation Technologies funding, two-phase oxide ceramics developed for superior high-temperature wear resistance in NASA's High Operating Temperature Propulsion Components (HOTPC) project and new two-layered carbon nanotube (CNT) coatings (CNT topcoat/iron bondcoat/quartz substrate) developed in NASA's Revolutionary Aeropropulsion Concepts (RAC) project have been chosen as a materials couple for aerospace applications, including micromachines, in the nanotechnology lubrication task because of their potential for superior friction and wearf properties in air and in an ultrahigh vacuum, spacelike environment. At the NASA Glenn Research Center, two-phase oxide ceramic eutectics, Al2O3/ZrO2(Y2O3), were directionally solidified using the laser-float-zone process, and carbon nanotubes were synthesized within a high-temperature tube furnace at 800 C. Physical vapor deposition was used to coat all quartz substrates with 5-nm-thick iron as catalyst and bondcoat, which formed iron islands resembling droplets and serving as catalyst particles on the quartz. A series of scanning electron micrographs showing multiwalled carbon nanotubes directionally grown as aligned 'nanograss' on quartz is presented. Unidirectional sliding friction eperiments were conducted at Glenn with the two-layered CNT coatings in contact with the two-phase Al2O3/ZrO2(Y2O3) eutectics in air and in ultrachigh vacuum.

The main criteria for judging the performance of the materials couple for solid lubrication and antistick applications in a space environment were the coefficient of friction and the wear resistance (reciprocal of wear rate), which had to be less than 0.2 and greater than 10(exp 5) N(raised dot)/cubic millimetes, respectively, in ultrahigh vacuum. In air, the coefficient of friction for the CNT coatings in contact with Al2O3/ZrO2 (Y2O3) eutectics was 0.04, one-fourth of that for quartz. In an ultrahigh vacuum, the coefficient of friction for CNT coatings in contact with Al2O3/ZrO2 (Y2O3) was one-third of that for quartz. The two-phase Al2O3/ZrO2 (Y2O3) eutectic coupled with the two-layered CNT coating met the coefficient of friction and wear resistance criteria both in air and in an ultrahigh vacuum, spacelike environment. This material's couple can dramatically improve the stiction (or adhesion), friction, and wear resistance of the contacting surfaces, which are major issues for microdevices and micromachines.
Author (revised)
Carbon Nanotubes; Nanotechnology; Aerospace Engineering; Oxides; Ceramics; Micromachining

20050192261 NASA Glenn Research Center, Cleveland, OH, USA
Hafnia-Based Materials Developed for Advanced Thermal/Environmental Barrier Coating Applications
Zhu, Dongming; Miller, Robert A.; Research and Technology 2003; May 2004; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Thermal and environmental barrier coatings (T/EBCs) will play a crucial role in advanced gas turbine engine systems because of their ability to significantly increase engine operating temperatures and reduce cooling requirements, and thus help achieve engine goals of low emissions and high efficiency. Under the NASA Ultra-Efficient Engine Technology (UEET) Project, advanced T/EBCs are being developed for low-emission SiC/SiC ceramic matrix composite (CMC) combustor applications by extending the CMC liner and vane temperature capability to 1650 C (3000 F) in oxidizing and water-vaporcontaining combustion environments. The coating system is required to have increased phase stability, lower lattice and radiation thermal conductivity, and improved sintering and thermal stress resistance under high-heat-flux and thermal-cycling engine conditions. Advanced heat-flux testing approaches (refs. 1 to 4) have been established at the NASA Glenn Research Center for 1650 C coating developments. The simulated combustion water-vapor environment is also being incorporated into the heat-flux test capabilities (ref. 3).
Derived from text
Thermal Control Coatings; Coatings; Gas Turbine Engines

20050192291 Institute of Space Medico-Engineering, Beijing, China
Design of Mechanical Structure Dynamic Characteristics and Development of Verification System
Ma, Ai-Jun; Li, Chen; Liu, Hong-Ying; Feng, Xue-Mei; Huang, Xiao-Hui; Lu, Lai-Jie; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 140-143; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to present an effective method for structural dynamic characteristics design, required design and test means for space products' development. Computational modal analysis method was used to evaluate natural frequencies and modes of the products in the beginning of design, and test modal analysis method was used to identify the dynamic parameters of products in the test period. The proposed computational modal analysis system is capable of making static and dynamic analysis, as well as natural frequencies and modes analysis of the structure, and this system could be applied in mechanical structure dynamic characteristics design. The proposed test modal analysis system could acquire real time force and acceleration signals, and obtain the basic modal parameters by processing the sampled data. This system could be used to modify mechanical products' dynamic characteristics and decrease vibration amplitude. The computational and test results of two test models demonstrated that the developed computational and test modal system is effective. The method can be used for design of structural dynamic characteristics of space products.
Author (revised)
Dynamic Characteristics; Dynamic Structural Analysis; Systems Engineering

20050192397 NASA Glenn Research Center, Cleveland, OH, USA
Stirling Microregenerators Fabricated and Tested
Moran, Matthew E.; Research and Technology 1999; March 2000; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A mesoscale Stirling refrigerator patented by the NASA Glenn Research Center is currently under development. This refrigerator has a predicted efficiency of 30 percent of Carnot and potential uses in electronics, sensors, optical and radiofrequency systems, microarrays, and microsystems. The mesoscale Stirling refrigerator is most suited to volume-limited

applications that require cooling below the ambient or sink temperature. Primary components of the planar device include two diaphragm actuators that replace the pistons found in traditional-scale Stirling machines and a microregenerator that stores and releases thermal energy to the working gas during the Stirling cycle. Diaphragms are used to eliminate frictional losses and bypass leakage concerns associated with pistons, while permitting reversal of the hot and cold sides of the device during operation to allow precise temperature control. Three candidate microregenerators were fabricated under NASA grants for initial evaluation: two constructed of porous ceramic, which were fabricated by Johns Hopkins Applied Physics Laboratory, and one made of multiple layers of nickel and photoresist, which was fabricated by Polar Thermal Technologies. The candidate regenerators are being tested by Johns Hopkins Applied Physics in a custom piezoelectric-actuated test apparatus designed to produce the Stirling refrigeration cycle. In parallel with the regenerator testing, Johns Hopkins is using deep reactive ion etching to fabricate electrostatically driven, comb-drive diaphragm actuators. These actuators will drive the Stirling cycle in the prototype device. The top photograph shows the porous ceramic microregenerators. Two microregenerators were fabricated with coarse pores and two with fine pores. The bottom photograph shows the test apparatus parts for evaluating the microregenerators, including the layered nickel-and-photoresist regenerator fabricated using LIGA techniques.
Author
Fabrication; Regenerators; Refrigerators; Stirling Cycle; Microelectronics

20050192403 NASA Glenn Research Center, Cleveland, OH, USA
NASA Multidimensional Stirling Convertor Code Developed
Tew, Roy C.; Thieme, Lanny G.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A high-efficiency Stirling Radioisotope Generator (SRG) for use on potential NASA Space Science missions is being developed by the Department of Energy, Lockheed Martin, Stirling Technology Company, and the NASA Glenn Research Center. These missions may include providing spacecraft onboard electric power for deep space missions or power for unmanned Mars rovers. Glenn is also developing advanced technology for Stirling convertors, aimed at substantially improving the specific power and efficiency of the convertor and the overall power system. Performance and mass improvement goals have been established for second- and third-generation Stirling radioisotope power systems. Multiple efforts are underway to achieve these goals, both in house at Glenn and under various grants and contracts. These efforts include the development of a multidimensional Stirling computational fluid dynamics code, high-temperature materials, advanced controllers, an end-to-end system dynamics model, low-vibration techniques, advanced regenerators, and a lightweight convertor. Under a NASA grant, Cleveland State University (CSU) and its subcontractors, the University of Minnesota (UMN) and Gedeon Associates, have developed a twodimensional computer simulation of a CSUmod Stirling convertor. The CFD-ACE commercial software developed by CFD Research Corp. of Huntsville, Alabama, is being used. The CSUmod is a scaled version of the Stirling Technology Demonstrator Convertor (TDC), which was designed and fabricated by the Stirling Technology Company and is being tested by NASA. The schematic illustrates the structure of this model. Modeled are the fluid-flow and heat-transfer phenomena that occur in the expansion space, the heater, the regenerator, the cooler, the compression space, the surrounding walls, and the moving piston and displacer. In addition, the overall heat transfer, the indicated power, and the efficiency can be calculated. The CSUmod model is being converted to a two-dimensional model of the TDC at NASA Glenn. Validation of the multidimensional Stirling code is an important part of the grant effort. UMN has been generating data in an oscillating-flow test facility using two different test sections: a 90 turn and a cooler/regenerator/heater test section. CSU has created computational fluid dynamics models of both these test sections and has been making comparisons with the data, then improving their models to improve the agreement with the test data. CSU has also been using data available in the literature for code validation. UMN is now preparing to begin fabrication of a new 180 turn test section that will be more representative of certain portions of the Stirling engine geometry. Simulations to almost periodic steady state with the two-dimensional CSUmod model indicate that, to reach periodic steady state on a single 2-GHz desktop computer, 75 to 100 complete simulation cycles would be required and between 1 and 2 months of computer time. Therefore, Glenn has purchased the first 8 computers, of a 64-computer cluster, to be run in parallel to accelerate the simulation. On the basis of CFD Research Corp.'s experience with running the parallelized version of CFD-ACE on their clusters, we estimate that the complete 64-computer cluster will reduce simulation computing time by a factor of about 40. Plans are to continue development of these multidimensional Stirling codes and to use them to study the fluid-flow and heat-transfer phenomena that occur inside Stirling convertors. This is expected to lead to improved thermodynamic loss understanding, onedimensional design and performance codes, and engine performance.
Author
Computational Fluid Dynamics; Fabrication; NASA Space Programs; Stirling Engines; Converters; Computer Programs

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QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, quality control, inspection, maintainability, and standardization.

20050189253 Lawrence Livermore National Lab., Livermore, CA USA
Nondestructive Evaluation
Martz, H. E.; Jan. 1998; 42 pp.; In English
Report No.(s): DE2004-15009528; UCRL-ID-129207; No Copyright; Avail: Department of Energy Information Bridge

The Nondestructive Evaluation (NDE) thrust area at Lawrence Livermore National Laboratory (LLNL) supports initiatives that advance inspection science and technology. The goal is to provide cutting-edge technologies, that show promise for quantitative inspection and characterization tools two to three years into the future. The NDE thrust area supports a multidisciplinary team, consisting of mechanical and electronics engineers, physicists, materials and computer scientists, chemists, technicians, and radiographers. These team members include personnel that cross departments within LLNL, and some are from academia and industry, within the US and abroad. This collaboration brings together the necessary and diver disciplines to provide the key scientific and technological advancements required to meet LLNL programmatic and industrial NDE challenges. The primary contributions of the NDE thrust area this year are described in these five reports: (1) Image Recovery Techniques for X-Ray Computed Tomography for Limited-Data Environments; (2) Techniques for Enhancing Laser Ultrasonic Nondestructive Evaluation; (3) Optical Inspection of Glass-Epoxy Bonds; (4) Miniature X-Ray Source Development; and (5) Improving Computed Tomography Design and Operation Using Simulation Tools.
NTIS
Nondestructive Tests; Research Facilities; Multidisciplinary Research; Teams; Computer Aided Tomography; X Ray Analysis; Laser Applications

20050192098 NASA Lewis Research Center, Cleveland, OH, USA
Nondestructive Evaluation Correlated with Finite Element Analysis
Abdul-Azid, Ali; Baaklini, George Y.; Research and Technology 1998; April 1999; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Advanced materials are being developed for use in high-temperature gas turbine applications. For these new materials to be fully utilized, their deformation properties, their nondestructive evaluation (NDE) quality and material durability, and their creep and fatigue fracture characteristics need to be determined by suitable experiments. The experimental findings must be analyzed, characterized, modeled and translated into constitutive equations for stress analysis and life prediction. Only when these ingredients - together with the appropriate computational tools - are available, can durability analysis be performed in the design stage, long before the component is built. One of the many structural components being evaluated by the NDE group at the NASA Lewis Research Center is the flywheel system. It is being considered as an energy storage device for advanced space vehicles. Such devices offer advantages over electrochemical batteries in situations demanding high power delivery and high energy storage per unit weight. In addition, flywheels have potentially higher efficiency and longer lifetimes with proper motor-generator and rotor design. Flywheels made of fiber-reinforced polymer composite material show great promise for energy applications because of the high energy and power densities that they can achieve along with a burst failure mode that is relatively benign in comparison to those of flywheels made of metallic materials Therefore, to help improve durability and reduce structural uncertainties, we are developing a comprehensive analytical approach to predict the reliability and life of these components under these harsh loading conditions. The combination of NDE and two- and three-dimensional finite element analyses (e.g., stress analyses and fracture mechanics) is expected to set a standardized procedure to accurately assess the applicability of using various composite materials to design a suitable rotor/flywheel assembly.
Author
Nondestructive Tests; Finite Element Method; Structural Analysis

20050192279 NASA Glenn Research Center, Cleveland, OH, USA
SAVANT: Solar Array Verification and Analysis Tool Demonstrated
Chock, Ricaurte; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The photovoltaics (PV) industry is now being held to strict specifications, such as end-oflife power requirements, that force them to overengineer their products to avoid contractual penalties. Such overengineering has been the only reliable way to meet such specifications. Unfortunately, it also results in a more costly process than is probably necessary. In our conversations with the PV industry, the issue of cost has been raised again and again. Consequently, the Photovoltaics and

Space Environment Effects branch at the NASA Glenn Research Center at Lewis Field has been developing a software tool to address this problem. SAVANT, Glenn's tool for solar array verification and analysis is in the technology demonstration phase. Ongoing work has proven that more efficient and less costly PV designs should be possible by using SAVANT to predict the on-orbit life-cycle performance. The ultimate goal of the SAVANT project is to provide a user-friendly computer tool to predict PV on-orbit life-cycle performance. This should greatly simplify the tasks of scaling and designing the PV power component of any given flight or mission. By being able to predict how a particular PV article will perform, designers will be able to balance mission power requirements (both beginning-of-life and end-of-life) with survivability concerns such as power degradation due to radiation and/or contamination. Recent comparisons with actual flight data from the Photovoltaic Array Space Power Plus Diagnostics (PASP Plus) mission validate this approach.
Author
Solar Arrays; Performance Prediction; Reliability Analysis; Computer Programs

20050192335 NASA Glenn Research Center, Cleveland, OH, USA
Hubble Space Telescope Degradation Data Used for Ground-Based Durability Projection of Insulation on the International Space Station
deGroh, Kim K.; Banks, Bruce A.; Dever, Joyce A.; Hodermarsky, Janet C.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Ground-based environmental durability tests have indicated that exposing materials in accelerated tests to known spacecraft mission degradation sources predicted by an environmental model does not simulate the extent of damage that occurs in the space environment. The reasons for this may include the complex nature of the space environment, which is not simulated completely in any ground-based facility, the extreme differences in exposure rates in space and in ground tests, and inaccuracies in environmental models. One approach to overcoming the difficulties in simulating the space environment using ground-based testing is to calibrate the facility using data from actual space-exposed materials to determine exposure levels required to replicate degraded properties observed in space. Research was conducted at the NASA Glenn Research Center to develop a ground-to-space correlation method that determines the durability of Teflon-based insulation for the International Space Station (ISS) by using data obtained in a ground facility and degraded Teflon thermal insulation retrieved from the Hubble Space Telescope.
Author
Space Environment Simulation; Environmental Tests; Accelerated Life Tests; Hubble Space Telescope; International Space Station; Thermal Insulation; Space Weathering

20050192386 NASA Glenn Research Center, Cleveland, OH, USA
Composite Flywheels Assessed Analytically by NDE and FEA
Abdul-Aziz, Ali; Baaklini, George Y.; Research and Technology 1999; March 2000; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As an alternative to expensive and short-lived lead-acid batteries, composite flywheels are being developed to provide an uninterruptible power supply for advanced aerospace and industrial applications. Flywheels can help prevent irregularities in voltage caused by power spikes, sags, surges, burnout, and blackouts. Other applications include load-leveling systems for wind and solar power facilities, where energy output fluctuates with weather. Advanced composite materials are being considered for these components because they are significantly lighter than typical metallic alloys and have high specific strength and stiffness. However, much more research is needed before these materials can be fully utilized, because there is insufficient data concerning their fatigue characteristics and nonlinear behavior, especially at elevated temperatures. Moreover, these advanced types of structural composites pose greater challenges for nondestructive evaluation (NDE) techniques than are encountered with typical monolithic engineering metals. This is particularly true for ceramic polymer and metal matrix composites, where structural properties are tailored during the processing stages. Current efforts involving the NDE group at the NASA Glenn Research Center at Lewis Field are focused on evaluating many important structural components, including the flywheel system. Glenn's in-house analytical and experimental capabilities are being applied to analyze data produced by computed tomography (CT) scans to help assess the damage and defects of high-temperature structural composite materials. Finite element analysis (FEA) has been used extensively to model the effects of static and dynamic loading on aerospace propulsion components. This technique allows the use of complicated loading schemes by breaking the complex part geometry into many smaller, geometrically simple elements.
Derived from text
Nondestructive Tests; Finite Element Method; Flywheels; Composite Materials

20050192389 NASA Glenn Research Center, Cleveland, OH, USA

Test Standard Developed for Determining the Life Prediction Parameters of Advanced Structural Ceramics at Elevated Temperatures

Choi, Sung R.; Gyekenyeski, John P.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The process of slow crack growth often limits the service life of structural ceramic components. Therefore, it is important to develop a test methodology for accurately determining the life prediction parameters required for component life prediction. In addition, this methodology should be useful in determining the influences of component processing variables and composition on the slow crack growth and strength behavior of newly developed or existing materials, thus allowing component processing to be tailored and optimized to specific needs. In 1998, the authors initiated the development of a test method to determine the life prediction parameters of advanced structural ceramics at elevated temperatures. Briefly, the test method utilizes constant stress-rate testing to determine strengths as a function of the applied stress rate at elevated temperatures. The merit of this method lies in its simplicity: strengths are measured in a routine manner at four or more applied stress rates through the application of constant displacement or loading rates. The slow crack growth parameters necessary for life prediction are then determined from a simple relationship between the strength and the stress rate.

Derived from text

Life (Durability); Refractory Materials; Ceramics; Stress Measurement

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STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

20050186897 NASA Lewis Research Center, Cleveland, OH, USA

Continuum Damage Mechanics Used to Predict the Creep Life of Monolithic Ceramics

Powers, Lynn M.; Jadaan, Osama M.; Research and Technology 1997; April 1998; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Significant improvements in propulsion and power generation for the next century will require revolutionary advances in high-temperature materials and structural design. Advanced ceramics are candidate materials for these elevated temperature applications. High-temperature and long-duration applications of monolithic ceramics can place their failure mode in the creep rupture regime. An analytical methodology in the form of the integrated design program-Ceramics Analysis and Reliability Evaluation of Structures/Creep (CARES/Creep) has been developed by the NASA Lewis Research Center to predict the life of ceramic structural components subjected to creep rupture conditions. This program utilizes commercially available finite element packages and takes into account the transient state of stress and creep strain distributions (stress relaxation as well as the asymmetric response to tension and compression). The creep life of a component is discretized into short time steps, during which the stress distribution is assumed constant. Then, the damage is calculated for each time step on the basis of a modified Monkman-Grant (MMG) creep rupture criterion. The cumulative damage is subsequently calculated as time elapses in a manner similar to Miner's rule for cyclic fatigue loading. Failure is assumed to occur when the normalized cumulative damage at any point in the component reaches unity. The corresponding time is the creep rupture life for that component.

Derived from text

Continuum Mechanics; Stress-Strain Relationships; Ceramics; Failure Analysis

20050186899 Southwest Research Inst., San Antonio, TX, USA

Probabilistic Fracture Mechanics Analysis of the Orbiter's LH2 Feedline Flowliner

Bonacuse, Peter J., Technical Monitor; Hudak, Stephen J., Jr.; Huyse, Luc; Chell, Graham; Lee, Yi-Der; Riha, David S.; Thacker, Ben; McClung, Craig; Gardner, Brian; Leverant, Gerald R.; Unruh, Jim, et al.; June 2005; 165 pp.; In English

Contract(s)/Grant(s): NAS1-00135; WBS 22-104-08-41

Report No.(s): NASA/CR-2005-213585; E-15052; No Copyright; Avail: CASI; A08, Hardcopy

Work performed by Southwest Research Institute (SwRI) as part of an Independent Technical Assessment (ITA) for the NASA Engineering and Safety Center (NESC) is summarized. The ITA goal was to establish a flight rationale in light of a history of fatigue cracking due to flow induced vibrations in the feedline flowliners that supply liquid hydrogen to the space shuttle main engines. Prior deterministic analyses using worst-case assumptions predicted failure in a single flight. The current

work formulated statistical models for dynamic loading and cryogenic fatigue crack growth properties, instead of using worst-case assumptions. Weight function solutions for bivariant stressing were developed to determine accurate crack 'driving-forces'. Monte Carlo simulations showed that low flowliner probabilities of failure (POF = 0.001 to 0.0001) are achievable, provided pre-flight inspections for cracks are performed with adequate probability of detection (POD)-specifically, 20/75 mils with 50%/99% POD. Measurements to confirm assumed POD curves are recommended. Since the computed POFs are very sensitive to the cyclic loads/stresses and the analysis of strain gage data revealed inconsistencies with the previous assumption of a single dominant vibrant mode, further work to reconcile this difference is recommended. It is possible that the unaccounted vibrational modes in the flight spectra could increase the computed POFs.
Author
Fatigue (Materials); Crack Propagation; Fracture Mechanics; Probability Theory; Dynamic Loads

20050187055 State Univ. of New York, Buffalo, NY, USA
Scissor-Jack-Damper Energy Dissipation System
Sigaher-Boyle, A. N.; Constantinou, M. C.; Dec. 01, 2004; 268 pp.; In English
Report No.(s): PB2005-108221; No Copyright; Avail: CASI; A12, Hardcopy

This report describes an energy dissipation system configuration that extends the utility of fluid viscous damping devices to structural systems that are characterized by small interstory drifts and velocities. The geometry of the brace and damper assembly is such that the system resembles a jacking mechanism, and thus the name scissor-jack-damper energy dissipation system is adopted. The system is a variant of the toggle-brace-damper system, and offers the advantage of a more compact configuration. A theoretical treatment of the scissor-jack-damper system is presented and its effectiveness is demonstrated through testing of a large-scale steel framed model structure under imposed harmonic displacement on the strong floor, as well as dynamic excitations on the earthquake simulator. Experiments demonstrate that despite its small size, the scissor-jack system provides a significant amount of damping while also substantially reducing the seismic response of the tested structure. Comparisons of response-history and simplified analyses with the experimental findings produce results that are consistent. Application of the scissor-jack-damper system in a new building structure in Cyprus is described.
NTIS
Energy Dissipation; Steel Structures; Viscous Damping

20050187116 Kentucky Univ., Lexington, KY USA
Baseline Modeling of the Maysville Cable-Stayed Bridge over the Ohio River
Harik, I. E.; Hu, J.; Smith, S. W.; Ren, W. X.; Zhao, T.; Jul. 2005; 154 pp.; In English
Report No.(s): PB2005-107426; KTC-05-10/FRT104-00-1F; No Copyright; Avail: CASI; A08, Hardcopy

This report presents the baseline modeling of the Maysville cable-stayed bridge which connects Maysville, Kentucky and Aberdeen, Ohio over the Ohio River. The objective of this study is to establish the bridge baseline model via the dynamics-based technique and finite element method. The scope of research includes finite element modeling and modal analysis, field free vibration testing, finite element model calibration using field test results, and cable dynamic testing and modeling. It is demonstrated that a cable-stayed bridge is a highly pre-stressed structure. The stress stiffening of cable elements plays an important role in both static and dynamic analysis. The large deflection analysis has shown that large deflection has the limited effect on the member deflections. Dominate dynamic response modes in the low frequency range contain vertical and transverse directions. The free vibration modes of the bridge are complicated and coupled. A good agreement of frequencies has been found between finite element modeling and in field free vibration testing after calibrating the finite element model. But, the better matching for higher modes is not expected and not realistic, as the experimental model properties of the bridge come from the output-only measurement. The calibrated finite element model may be used as a baseline in the future structural analysis and monitoring of the Maysville cable-stayed bridge.
NTIS
Bridges (Structures); Structural Analysis; Finite Element Method; Mathematical Models

20050188544 NASA Lewis Research Center, Cleveland, OH, USA
Novel Method Used to Inspect Curved and Tubular Structural Materials
Roth, Don J.; Baaklini, George Y.; Carney, Dorothy V.; Bodis, James R.; Rauser, Richard W.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

At the NASA Lewis Research Center, a technique for the ultrasonic characterization of plates has been extended to tubes and to curved structures in general. In this technique, one performs measurements that yield a thickness-independent value of

the local through-the-thickness speed of sound in a specimen. From such measurements at numerous locations across the specimen, one can construct a map of velocity as a function of location. The gradients of velocity indicated by such a map indicate local through-the-thickness-averaged microstructural parameters that affect the speed of sound. Such parameters include the pore volume fraction, mass density, fiber volume fraction (in the case of a composite material), and chemical composition. Apparatus was designed to apply the technique to tubular and other curved specimens.
Derived from text
Structural Analysis; Composite Materials; Thick Plates

20050189179 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
An Investigation of a Simplified Gouging Model
Rickerd, Gregory S.; Mar. 2005; 162 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434269; AFIT/GAE/ENY/05-M19; No Copyright; Avail: CASI; A08, Hardcopy

Gouging is a type of structural failure that becomes important when two metals slide against each other at velocities in the range of 1.5 kilometers per second. A computer model has previously been used to model the development of gouging at the Holloman High Speed Test Track. This model has not been experimentally verified to be correct, due to the complexity of the model. This research develops a simplified model that can be experimentally verified. The computer program utilized in this research was studied to determine the most appropriate options to use in simulations. This was accomplished by modeling a Taylor impact test and comparing to published experimental results. The cylindrical impact specimen utilized in the simplified model was developed through use of the Buckingham-Pi theorem, and can be fired from most standard compressed air guns. Simulations using the simplified model showed excellent agreement with simulations using the physical sled properties. Plasticity observed in both the rod and target was very similar to that seen in the physical sled simulations. The high-pressure core, which initiates gouging in the physical sled simulation, was found to exist in the simplified model as well.
DTIC
Metals; Structural Failure

20050192065 Bureau of Reclamation, Denver, CO, USA
Evaluation of USBR Cyclic Simple Shear and Cyclic Triaxial Apparatus for Testing Dynamic Properties
Rosenfield, J.; Dec. 1985; 22 pp.; In English
Report No.(s): PB2005-106519; GR-85-11; No Copyright; Avail: CASI; A03, Hardcopy

The Engineering and Research Center geotechnical laboratory has both cyclic simple shear and cyclic triaxial test apparatus. However, the cyclic simple shear device needs modification. The purpose of this report is to evaluate the effectiveness of the cyclic simple shear test and the cyclic triaxial test in obtaining the shear modulus and the damping ratio of soils and to determine whether upgrading the cyclic simple shear apparatus is necessary.
NTIS
Dynamic Characteristics; Soils; Cyclic Loads; Shear Properties

20050192153 NASA Lewis Research Center, Cleveland, OH, USA
Thermomechanical Fatigue Durability of T650-35/PMR-15 Sheet-Molding Compound Evaluated
Castelli, Michael G.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

High-performance polymer matrix composites (PMC's) continue to be the focus of a number of research efforts aimed at developing cost-effective, lightweight material alternatives for advanced aerospace and aeropropulsion applications. These materials not only offer significant advantages in specific stiffness and strength over their current metal counterparts, but they can be designed and manufactured to eliminate joints and fasteners by combining individual components into integral subassemblies, thus making them extremely attractive for commercial applications. With much emphasis on the low-cost manufacturing aspects of advanced composite structures, there is heightened interest in high-performance sheet-molding compounds (SMC's). Researchers at the NASA Lewis Research Center, in cooperation with the Allison Advanced Development Company, completed an investigation examining the use of T650-35/PMR-15 SMC for a midstage inner-vane endwall application within a gas turbine engine compressor. This component resides in the engine flow path and is subjected not only to high airflow rates, but also to elevated temperatures and pressures. This application is unique in that it represents a very aggressive use of high-performance SMC's, raising obvious concerns related to durability and property retention in the presence of microstructural damage. Therefore, it was necessary to evaluate the fatigue behavior and damage tolerance of this

material subjected to a representative thermomechanical fatigue (TMF) mission-cycle loading spectrum.
Derived from text
Thermodynamics; Fatigue (Materials); Durability; Sheet Molding Compounds

20050192385 NASA Glenn Research Center, Cleveland, OH, USA
Time-Dependent Reversible-Irreversible Deformation Threshold Determined Explicitly by Experimental Technique
Castelli, Michael G.; Arnold, Steven M.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Structural materials for the design of advanced aeropropulsion components are usually subject to loading under elevated temperatures, where a material's viscosity (resistance to flow) is greatly reduced in comparison to its viscosity under low-temperature conditions. As a result, the propensity for the material to exhibit time-dependent deformation is significantly enhanced, even when loading is limited to a quasi-linear stress-strain regime as an effort to avoid permanent (irreversible) nonlinear deformation. An understanding and assessment of such time-dependent effects in the context of combined reversible and irreversible deformation is critical to the development of constitutive models that can accurately predict the general hereditary behavior of material deformation. To this end, researchers at the NASA Glenn Research Center at Lewis Field developed a unique experimental technique that identifies the existence of and explicitly determines a threshold stress k, below which the time-dependent material deformation is wholly reversible, and above which irreversible deformation is incurred. This technique is unique in the sense that it allows, for the first time, an objective, explicit, experimental measurement of k. The underlying concept for the experiment is based on the assumption that the material s time-dependent reversible response is invariable, even in the presence of irreversible deformation.
Derived from text
Deformation; Time Dependence; Structural Members; Viscosity; Stress-Strain-Time Relations

20050192390 NASA Glenn Research Center, Cleveland, OH, USA
Nonlinearity and Strain-Rate Dependence in the Deformation Response of Polymer Matrix Composites Modeled
Goldberg, Robert K.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

There has been no accurate procedure for modeling the high-speed impact of composite materials, but such an analytical capability will be required in designing reliable lightweight engine-containment systems. The majority of the models in use assume a linear elastic material response that does not vary with strain rate. However, for containment systems, polymer matrix composites incorporating ductile polymers are likely to be used. For such a material, the deformation response is likely to be nonlinear and to vary with strain rate. An analytical model has been developed at the NASA Glenn Research Center at Lewis Field that incorporates both of these features. A set of constitutive equations that was originally developed to analyze the viscoplastic deformation of metals (Ramaswamy-Stouffer equations) was modified to simulate the nonlinear, rate-dependent deformation of polymers. Specifically, the effects of hydrostatic stresses on the inelastic response, which can be significant in polymers, were accounted for by a modification of the definition of the effective stress. The constitutive equations were then incorporated into a composite micromechanics model based on the mechanics of materials theory. This theory predicts the deformation response of a composite material from the properties and behavior of the individual constituents. In this manner, the nonlinear, rate-dependent deformation response of a polymer matrix composite can be predicted.
Author
Nonlinearity; Strain Rate; Polymer Matrix Composites; Tensile Deformation

42
GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

20050187043 Occupational Safety and Health Administration, Washington, DC, USA
Excavations, 2002 Edition
January 2002; 48 pp.; In English
Report No.(s): PB2005-108281; OSHA-2226(REVISED 2002); No Copyright; Avail: CASI; A03, Hardcopy

Excavation and trenching are among the most hazardous construction operations. The Occupational Safety and Health

Administrations (OSHA) Excavation and Trenching standard, Title 29 of the Code of Federal Regulation (CFR), Part 1926.650, covers requirements for excavation and trenching operations. This booklet highlights key elements of the standard, shows ways to protect employees against cave-ins, and describes safe work practices for employees.
NTIS
Excavation; Hazards; Health; Safety

20050192418 NASA Glenn Research Center, Cleveland, OH, USA
New Technology-Large-Area Three- Dimensional Surface Profiling Using Only Focused Air-Coupled Ultrasound-Given 1999 R&D 100 Award
Roth, Don J.; Kautz, Harold E.; Abel, Phillip B.; Whalen, Mike F.; Hendricks, J. Lynne; Bodis, James R.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Surface topography, which significantly affects the performance of many industrial components, is normally measured with diamond-tip profilometry over small areas or with optical scattering methods over larger areas. To develop air-coupled surface profilometry, the NASA Glenn Research Center at Lewis Field initiated a Space Act Agreement with Sonix, Inc., through two Glenn programs, the Advanced High Temperature Engine Materials Program (HITEMP) and COMMTECH. The work resulted in quantitative surface topography profiles obtained using only high-frequency, focused ultrasonic pulses in air. The method is nondestructive, noninvasive, and noncontact, and it does not require light-reflective surfaces. Air surface profiling may be desirable when diamond-tip or laserbased methods are impractical, such as over large areas, when a significant depth range is required, or for curved surfaces. When the configuration is optimized, the method is reasonably rapid and all the quantitative analysis facilities are online, including two- and three-dimensional visualization, extreme value filtering (for faulty data), and leveling.
Derived from text
Topography; Surfaces; Ultrasonics

43
EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis of remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photography. For related instrumentation see *35 Instrumentation and Photography*.

20050192435 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Proceedings of the 12th JPL Airborne Earth Science Workshop
Green, Robert O.; [2004]; In English; 12th JPL Airborne Earth Science Workshop, 31 Mar. 2004, Pasadena, CA, USA; See also 20050192436 - 20050192460
Contract(s)/Grant(s): NAS7-03001
Report No.(s): JPL-Publ-04-6; Copyright; Avail: CASI; C01, CD-ROM

Participants at the 12th Airborne Earth Science Workshop reported science research and applications results with spectral images measured by the NASA Airborne Invisible/lnfrared Imaging Spectrometer (AVIRIS). The workshop was held in Pasadena, California, from February, 2003.
Author
Airborne Equipment; Earth Sciences; Infrared Spectrometers; Imaging Spectrometers

20050192436 Arizona Univ., AZ, USA
Use of EO-1 Hyperion Data for Inter-Sensor Calibration of Vegetation Indices
Huete, Alfredo; Miura, Tomoaki; Kim, HoJin; Yoshioka, Hiroki; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 7 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NCC5-478; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Numerous satellite sensor systems useful in terrestrial Earth observation and monitoring have recently been launched and their derived products are increasingly being used in regional and global vegetation studies. The increasing availability of multiple sensors offer much opportunity for vegetation studies aimed at understanding the terrestrial carbon cycle, climate change, and land cover conversions. Potential applications include improved multiresolution characterization of the surface (scaling); improved optical-geometric characterization of vegetation canopies; improved assessments of surface phenology

and ecosystem seasonal dynamics; and improved maintenance of long-term, inter-annual, time series data records. The Landsat series of sensors represent one group of sensors that have produced a long-term, archived data set of the Earth s surface, at fine resolution and since 1972, capable of being processed into useful information for global change studies (Hall et al., 1991).
Derived from text
Imaging Spectrometers; Earth Observations (From Space); Remote Sensing; Hyperion

20050192438 California Univ., Santa Barbara, CA, USA
Endmember Selection For Multiple Endmember Spectral Mixture Analysis
Dennison, Philip E.; Roberts, Dar A.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 6 pp.; In English; See also 20050192435; Original contains color illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Spectral mixture analysis (SMA) models image spectra as the linear combination of endmembers (Adams et al., 1993). By utilizing an invariable set of endmembers, SMA does not account for the absence of one of the endmembers or spectral variation within pure materials. Multiple endmember spectral mixture analysis (MESMA) addresses these issues by allowing endmembers to vary on a per pixel basis (Roberts et al., 1998). MESMA has been applied in a variety of environments for vegetation and snow mapping. Roberts et al. (1997; 1998; 2003) and Dennison et al. (2000) used MESMA to map vegetation species and land cover type in Southern California chaparral. Painter et al. (1998; 2003) mapped snow grain size in the Sierra Nevada of California using MESMA. MESMA has also been used to map vegetation in semi-arid environments (Okin et al., 2001).
Derived from text
Spectral Mixture Analysis; Thematic Mapping; Remote Sensing

20050192439 Colorado Univ., CO, USA
Relative Performance Of Hatch And Three Other Techniques For Atmospheric Correction Of Hyperion And Aviris Data
Goetz, Alexander F. H.; Kindel, Bruce; Ferri, Mario; Gutmann, Ethan; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 9 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The analysis of hyperspectral image data requires either the application of a radiative transfer model to correct radiance data from the sensor to reflectance or the simultaneous acquisition of surface spectral reflectance data to obtain correction factors for the solar irradiance and atmospheric transmission and scattering. The transmission, and in some cases the scattering, is highly location dependent because the major absorber is water vapor, a poorly mixed gas. Therefore, radiative transfer modeling is required to extend point measurements to the rest of the image. Several models have been developed for atmospheric correction and four of them, ATREM (Gao et al., 1993), HATCH (Qu et al., 2003), ACORN (Miller, 2002) and FLAASH (Matthew et al., 2000) have gained prominence. The latter two are commercially available. In this paper we describe the results of using model and measured reflectances propagated to the top of the atmosphere using MODTRAN4 (Adler-Golden et al., 1999) and retrieved using the above models for different precipitable water vapor values. In addition, we have applied the models to AVIRIS and Hyperion data in order to compare the average reflectances obtained with each model, and compared the results for the derivation of spectral reflectance under a variety of precipitable water vapor conditions.
Derived from text
Airborne Equipment; Infrared Spectrometers; Atmospheric Correction

20050192440 Bonn Univ., Germany
Unsupervised Change Detection for Hyperspectral Images
Frank, Michael; Canty, Mort; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 10 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Change detection is a central task in the field of remote sensing. Detection of anthropogenic or natural impacts on landcover is essential for many environmental studies. On the regional to global scale, only multitemporal remote sensing is capable of monitoring landcover changes caused by short-term phenomena such as fire hazards and seasonal vegetation change, or long-term phenomena such as urban development and desertification in a practical way. A variety of change detection techniques has been developed for multispectral satellite and airborne imagery, including arithmetic operations,

methods of principle component analysis as well as post-classification comparison and multitemporal classification [Singh, 1989], [Roberts et al., 1998a], [Yuan et al., 1998]. Spectral change detection techniques rely on the principle that a difference exists in the spectral response of a pixel on two dates if the biophysical material within the instantaneous field of view (IFOV) has changed between these dates [Jensen, 1996]. Hyperspectral change detection has many advantages over multispectral data in detecting and discriminating surface properties because it provides a continuous spectrum across a range in wavelengths [Green et al., 1998]. Nevertheless, only few attempts have been made for change detection based on hyperspectral images [Wiemker et al., 1997]. Until recently, the main limiting factor on the employment of hyperspectral sensors in change detection studies has been inadequate multitemporal coverage [Garcia and Ustin, 2001]. But with the launch of the hyperspectral sensor Hyperion [EO1, 2000] and the growing number of hyperspectral airborne sensors, more of these images may be available soon, and with them a greater need for hyperspectral change detection methods.
Derived from text
Change Detection; Man Environment Interactions; Remote Sensing; Satellite Imagery

20050192444 Arizona Univ., Tucson, AZ, USA
Discrimination And Biophysical Characterization Of Brazilian Cerrado Physiognomies With Eo-1 Hyperspectral Hyperion
Miura, Tomoaki; Huete, Alfredo R.; Ferreira, Laerte G.; Sano, Edson E.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 6 pp.; In English; See also 20050192435; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS5-31364; NCC5-478; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The savanna, typically found in the sub-tropics and seasonal tropics, are the dominant vegetation biome type in the southern hemisphere, covering approximately 45% of the South America. In Brazil, the savanna, locally known as 'cerrado,' is the most intensely stressed biome with both natural environmental pressures (e.g., the strong seasonality in weather, extreme soil nutrient impoverishment, and widespread fire occurrences) and rapid/aggressive land conversions (Skole et al., 1994; Ratter et al., 1997). Better characterization and discrimination of cerrado physiognomies are needed in order to improve understanding of cerrado dynamics and its impact on carbon storage, nutrient dynamics, and the prospect for sustainable land use in the Brazilian cerrado biome. Satellite remote sensing have been known to be a useful tool for land cover and land use mapping (Rougharden et al., 1991; Hansen et al., 2000). However, attempts to discriminate and classify Brazilian cerrado using multi-spectral sensors (e.g., Landsat TM) and/or moderate resolution sensors (e.g., NOAA AVHRR NDVI) have often resulted in a limited success due partly to small contrasts depicted in their multiband, spectral reflectance or vegetation index values among cerrado classes (Seyler et al., 2002; Fran a and Setzer, 1998). In this study, we aimed to improve discrimination as well as biophysical characterization of the Brazilian cerrado physiognomies with hyperspectral remote sensing. We used Hyperion, the first satellite-based hyperspectral imager, onboard the Earth Observing-1 (EO-1) platform.
Derived from text
Remote Sensing; Biophysics; Ecosystems; Land Use; Thematic Mapping; Vegetation

20050192445 Spectral International, Inc., USA
Using AVIRIS In The NASA BAA Project To Evaluate The Impact Of Natural Acid Drainage On Colorado Watersheds
Hauff, Phoebe L.; Coulter, David W.; Peters, Douglas C.; Sares, Matthew A.; Prosh, Eric C.; Henderson, Frederick B., III; Bird, David; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 10 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Colorado Geological Survey and the co-authors of this paper were awarded one of 15 NASA Broad Agency Announcement (BAA) grants in 2001. The project focuses on the use of hyperspectral remote sensing to map acid-generating minerals that affect water quality within a watershed, and to identify the relative contributions of natural and anthropogenic sources to that drainage. A further objective is to define the most cost-effective remote sensing instrument configuration for this application.
Derived from text
Airborne Equipment; Infrared Spectrometers; Remote Sensing

20050192446 California Univ., Davis, CA, USA

Applying Tafkaa For Atmospheric Correction of Aviris Over Coral Ecosystems In The Hawaiian Islands

Goodman, James A.; Montes, Marcos J.; Ustin, Susan L.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 6 pp.; In English; See also 20050192435; Original contains color and black and white illustrations

Contract(s)/Grant(s): NGT5-0208; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Growing concern over the health of coastal ecosystems, particularly coral reefs, has produced increased interest in remote sensing as a tool for the management and monitoring of these valuable natural resources. Hyperspectral capabilities show promising results in this regard, but as yet remain somewhat hindered by the technical and physical issues concerning the intervening water layer. One such issue is the ability to atmospherically correct images over shallow aquatic areas, where complications arise due to varying effects from specular reflection, wind blown surface waves, and reflectance from the benthic substrate. Tafkaa, an atmospheric correction algorithm under development at the U.S. Naval Research Laboratory, addresses these variables and provides a viable approach to the atmospheric correction issue. Using imagery from the Advanced Visible InfraRed Imaging Spectrometer (AVIRIS) over two shallow coral ecosystems in the Hawai ian Islands, French Frigate Shoals and Kane ohe Bay, we first demonstrate how land-based atmospheric corrections can be limited in such an environment. We then discuss the input requirements and underlying algorithm concepts of Tafkaa and conclude with examples illustrating the improved performance of Tafkaa using the same AVIRIS images.
Derived from text

Infrared Spectrometers; Remote Sensing; Imaging Spectrometers; Airborne Equipment; Atmospheric Correction; Imagery

20050192447 Farr View Consulting, Thornton, CO, USA

Using AVIRIS Data to Map and Characterize Subaerially and Subaqueously Erupted BasalticVolcanic Tephras: The Challenge of Mapping Low-Albedo Materials

Farrand, William H.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAG5-10577; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Increases in the signal-to-noise ratio (SNR) in AVIRIS has enabled the mapping and characterization of low albedo materials. Low albedo materials of interest include certain soils, man-made materials (asphalt, certain building materials, tires, etc.), and basaltic lava flows and ashes. Early in its history, the response of the AVIRIS sensor was not sensitive enough so that these low albedo materials could be reliably mapped. However, as indicated by Green and Pavri (2002) the noise equivalent delta radiance (NEdL) of AVIRIS in the 2001 flight season was below 0.010 in all but the shortest wavelength channels. This is approximately a ten-fold improvement from the 1989 flight season when NEdL was closer to 0.1 (Green et al., 1990). In the current investigation, AVIRIS data from the 2002 flight season collected over the Pavant Butte tuff cone, Tabernacle Hill tuff ring, and an associated lava flow in the Black Rock Desert of west central Utah were examined to determine how well these generally low albedo volcanic lavas and tephras could be discriminated from background materials. The Pavant Butte tuff cone was examined by the author in an earlier study with a 1989 AVIRIS dataset (Farrand and Singer,
Derived from text

Albedo; Infrared Spectrometers; Petrology

20050192448 Analytical Imaging and Geophysics, LLC, Boulder, CO, USA

Mineral Mapping with AVIRIS and EO-1 Hyperion

Kruse, Fred A.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color and black and white illustrations

Contract(s)/Grant(s): NCC5-495; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Imaging Spectrometry data or Hyperspectral Imagery (HSI) acquired using airborne systems have been used in the geologic community since the early 1980 s and represent a mature technology (Goetz et al., 1985; Kruse et al., 1999). The solar spectral range, 0.4 to 2.5 m, provides abundant information about many important Earth-surface minerals (Clark et al., 1990). In particular, the 2.0 to 2.5 m (SWIR) spectral range covers spectral features of hydroxyl-bearing minerals, sulfates, and carbonates common to many geologic units and hydrothermal alteration assemblages. Previous research has proven the ability of airborne and spaceborne hyperspectral systems to uniquely identify and map these and other minerals, even in sub-pixel abundances (Kruse and Lefkoff, 1993; Boardman and Kruse, 1994; Boardman et al., 1995; Kruse, et al., 1999). This paper describes a case history for a site in northern Death Valley, California and Nevada along with selected SNR

calculations/results for other sites around the world. Various hyperspectral mineral mapping results for this site have previously been presented and published (Kruse, 1988; Kruse et al., 1993, 1999, 2001, 2002, 2003), however, this paper presents a condensed summary of key details for hyperspectral data from 2000 and 2001 and the results of accuracy assessment for satellite hyperspectral data compared to airborne hyperspectral data used as ground truth.
Derived from text
Mineral Deposits; Infrared Spectrometers; Imagery; Hyperion; Thematic Mapping

20050192449 Carnegie Institution of Washington, Stanford, CA, USA
Hyperion Studies Of Crop Stress In Mexico
Lobell, David B.; Asner, Gregory P.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 6 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NAG5-8709; NCC5-480; NCC5-481; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Satellite-based measurements of crop stress could provide much needed information for cropland management, especially in developing countries where other precision agriculture technologies are too expensive (Pierce and Nowak 1999; Robert 2002). For example, detection of areas that are nitrogen deficient or water stressed could guide fertilizer and water management decisions for all farmers within the swath of the satellite. Several approaches have been proposed to quantify canopy nutrient or water content based on spectral reflectance, most of which involve combinations of reflectance in the form of vegetation indices. While these indices are designed to maximize sensitivity to leaf chemistry, variations in other aspects of plant canopies may significantly impact remotely sensed reflectance. These confounding factors include variations in canopy structural properties (e.g., leaf area index, leaf angle distribution) as well as the extent of canopy cover, which determines the amount of exposed bare soil within a single pixel. In order to assess the utility of spectral indices for monitoring crop stress, it is therefore not only necessary to establish relationships at the leaf level, but also to test the relative importance of variations in other canopy attributes at the spatial scale of the remote sensing measurement. In this context, the relative importance of a given attribute will depend on (1) the sensitivity of the reflectance index to variation in the attribute and (2) the degree to which the attribute varies spatially and temporally.
Derived from text
Hyperion; Plant Stress; Remote Sensing

20050192451 Colorado Univ., Boulder, CO, USA
AVIRIS And Archaeology In Southern Arizona
White, Devin Alan; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 9 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Arizona is a state that is experiencing unprecedented growth in both its economy and its population. Cities like Phoenix and Tucson are expanding at exponential rates, converting open space to tract home communities and strip malls. Underneath both Phoenix and Tucson, and extending out far into the Sonoran Desert, are tens of thousands of archaeological sites associated with the prehistoric culture known as the Hohokam (Crown and Judge, 1991; Gumerman, 1991). While archaeologists do not like the fact that dozens of Hohokam sites are destroyed every day in the name of progress, we do take some small comfort in the federal legislation that mandates that we get to find, document, excavate, and report on those sites thereby preserving some of Arizona s rich cultural heritage before they are destroyed. The most expensive and time-consuming aspect of this work, known as Cultural Resource Management (CRM), is survey. Most projects involve surveying a large piece of land on foot. Sites are recorded and ranked by perceived importance. The most important of these sites are either excavated (last resort) or avoided entirely (preferable), depending on the flexibility of the developer. If archaeological sites in southern Arizona were easily seen on the surface, as they generally are in other parts of the Southwest, survey would be relatively straightforward and inexpensive. However, Hohokam sites exhibit little to no surface expression that we can detect with the naked eye. The results of this dilemma have been disastrous. Construction crews find or destroy sites archaeologists missed and archaeologists sometimes end up digging in locations that yield no information.
Derived from text
Archaeology; Arizona; Infrared Spectrometers; Remote Sensing

20050192452 Natural Resources Conservation Service, Davis, CA, USA

Estimating Surface Soil Moisture in Simulated AVIRIS Spectra

Whiting, Michael L.; Li, Lin; Ustin, Susan L.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color illustrations

Contract(s)/Grant(s): NAG5-9360; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Soil albedo is influenced by many physical and chemical constituents, with moisture being the most influential on the spectra general shape and albedo (Stoner and Baumgardner, 1981). Without moisture, the intrinsic or matrix reflectance of dissimilar soils varies widely due to differences in surface roughness, particle and aggregate sizes, mineral types, including salts, and organic matter contents. The influence of moisture on soil reflectance can be isolated by comparing similar soils in a study of the effects that small differences in moisture content have on reflectance. However, without prior knowledge of the soil physical and chemical constituents within every pixel, it is nearly impossible to accurately attribute the reflectance variability in an image to moisture or to differences in the physical and chemical constituents in the soil. The effect of moisture on the spectra must be eliminated to use hyperspectral imagery for determining minerals and organic matter abundances of bare agricultural soils. Accurate soil mineral and organic matter abundance maps from air- and space-borne imagery can improve GIS models for precision farming prescription, and managing irrigation and salinity. Better models of soil moisture and reflectance will also improve the selection of soil endmembers for spectral mixture analysis.

Derived from text

Soils; Infrared Spectrometers; Imagery; Soil Moisture

20050192453 Cincinnati Univ., OH, USA

AmeriSat: Requirements Analysis for a Hyperspectral Land Remote Sensor Constellation for Energy Exploration

Beck, Richard; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 9 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The physical and economic well being of the USA of America depends upon a stable and affordable supply of abundant energy. Energy security for the United State of America will continue to depend primarily on fossil and nuclear fuels for the next few decades at a minimum. Efficient and successful exploration for new sources of energy requires precise and consistent geological surveys. Despite years of global exploration activity, much of the world and indeed even the USA has not been geologically surveyed at a scale appropriate for energy exploration, environmental hazard analysis, environmental protection or land use planning.

Author

Land Management; Remote Sensors; Land Use; Environment Protection

20050192454 Wollongong Univ., Australia

Assessment Of Hyperion For Characterizing Mangrove Communities

Demuro, Martina; Chisholm, Laurie; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 10 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Mapping the distribution of species and vegetation types in coastal wetlands has become important because of the need for wetland inventories and their biodiversity (Finlayson et al., 1999; Phinn and Finlayson, 1999). Vegetation is also regarded as a bio-indicator of site conditions and it is therefore important to understand changes in its distribution and the process acting upon it (K chler, 1988; Blasco et al., 1996; Muller, 1997; Klemas, 2001). Mapping methods need to be efficient and cost effective (Mumby et al., 1999) with satellite remote sensing systems having been used extensively for mapping the distribution of vegetation types in coastal wetlands and other environments (Gross et al., 1989; Phinn et al., 1999). The detection of vegetation types will depend directly on the sampling unit used by the sensor (pixel) and the area imaged. The signal recorded for each pixel is composed of a mixture of components that characterize each community, including the species, canopy openness, height and substrate. Broad-band multispectral imagery is usually analyzed using methods that classify whole pixels using limited spectral information (Vane and Goetz, 1993), which do not account for the problem of mixed pixels. The discrimination of vegetation types using satellite-borne sensors is usually based on the structure (height, openness) and broad vegetation categories (such as woody, perennial, evergreen) (Lewis, 1999; Holmgren and Thuresson, 1998). A common criticism of satellite remote sensing is its inability to define features of interest that are related to ecological processes because of the crude spectral and spatial dimensions of the images (Rougharden et al., 1991; Holmgren and Thuresson, 1998). Advantages of higher spectral resolution imagery include the acquisition of detailed spectral information of the features on

the ground (Ustin et al., 1991) and the possibility of image analysis procedures that aim to detect target spectra at a sub-pixel level (Curran, 1994; Clark, 1999; Mustard and Sunshine, 1999). Airborne hyperspectral data have been used to detect minerals and plant biochemicals that have distinct absorption features (Curran, 1994; Serrano et al., 2002) and species distribution (Dehaan and Taylor, 2002; Parker Williams and Hunt Jr., 2002). EO-1 Hyperion is the first satellite-borne hyperspectral sensor to orbit the Earth, capable of recording spectral information superior to previous satellite sensors. Hyperion differs from previous satellite sensors in that it records radiance in many narrow contiguous bands spanning the visible to the near infrared portion of the spectrum. Hyperion has a spatial resolution of 30 meters and records radiance in 220 bands spanning from the blue at 450 nm to the middle infrared at 2500 nm. Each band has a width of approximately 10 nm.
Author
Hyperion; Biological Diversity; Vegetation; Satellite Observation; Thematic Mapping; Image Analysis; Infrared Radiation

20050192456 Colorado Univ., Boulder, CO, USA
Ecosystem Impacts of Woody Encroachment In Texas: A Spatial Analysis Using AVIRIS
Martin, Roberta E.; Asner, Gregory P.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAG5-8709; NCC5-480; NCC5-481; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Woody encroachment, the increase of woody plant density relative to herbaceous vegetation, has been documented in drylands of Texas as well as worldwide (Archer 1994, Harrington and Harman 1995, Moleele et al. 2002). Over-grazing, fire suppression and climate change are implicated in the shift from open grasslands to ecosystems now populated by trees and shrubs (Scholes and Archer 1997, Archer et al. 2001), such as Prosopis glandulosa var. glandulosa (honey mesquite) in north Texas (Teague et al. 1997, Ansley et al. 2001, Asner et al. 2003a). Several studies have examined changes in ecosystem properties accompanying woody vegetation encroachment in the Southwest U.S., with research focused on increases in plant and soil carbon (C) and nitrogen (N) stores (Hoffman and Jackson 2000, Asner et al. 2003a), isotopic shifts in these pools (Boutton 1999, Archer et al. 2001), and increases in N cycling rates (Rundel et al. 1982, Hibbard et al. 2001). However, little is known regarding the impact of woody encroachment on N trace gas emissions from dryland regions such as Texas. NOx is produced in the soil during the processes of nitrification and denitrification (Firestone and Davidson 1989). The total N efflux from soils is most directly influenced by the internal cycling of N, which at a regionalscale, is controlled by the inputs and availability of N from vegetation via litterfall and subsequent decomposition (Robertson et al. 1989). Although plot-scale studies are critical to understanding controls over N oxide emissions, regionalization of the measurements is impeded by spatial variation in the factors contributing most to N cycling processes: soil properties (affecting soil moisture regimes and N stocks) and vegetation cover (affecting litter inputs and N uptake). While broad patterns in ecosystem structure and vegetation composition co-vary with general patterns of trace gas emissions (Matson 1997), there is no easily measured index of N availability that can be applied for regional-scale studies of N oxide fluxes. Remote sensing is arguably the only approach available to develop a spatially-explicit understanding of ecosystem processes. More specifically, remotely detectable spatial patterns in the distal controls over soil N properties, such as vegetation cover, land use and soil type (Robertson et al. 1989), should be exploited for regional studies of N oxide emissions. The woody encroachment phenomenon provides an opportunity to test the strength of the relationship between N oxide emissions and those factors controlling the fluxes that can be remotely measured. If such linkages can be firmly established, and if the spatial pattern of distal controls is relevant, then the combination of field measurements and remote sensing offers to improve regional-scale N oxide estimates. The paper presents the utility of linking field based sampling of soil NOx emissions with very high resolution remote sensing estimates of woody vegetation cover from the NASA AVIRIS, Airborne Visible-Infrared Imaging Spectrometer (Green et al. 1998, Asner and Green 2001) and automated spectral mixture analysis (Asner and Lobell 2000, Asner and Heidebrecht 2002) that provide a means to spatially extrapolate soil NOx emissions to the regional scale.
Derived from text
Ecosystems; Vegetation; Land Use; Climate Change; Grazing; Grasslands; Nitrogen Oxides; Spatial Distribution

20050192457 Boeing Co., Colorado Springs, CO, USA
Methods for Detecting Anomalies in AVIRIS Imagery
Penn, Brian S.; Wolboldt, Mark W.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 12 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

At a very small scale the Earth s surface is heterogeneous, but the spatial resolution of current satellite and airborne sensors gives the appearance of homogeneity. This is an artifact of digital sensors that integrate the signal over well-defined

instantaneous angular fields of view and spectral ranges. Because of limitations in spatial resolution, cursory examination of remotely-sensed imagery data leads to the conclusion there is a significant amount of redundant information, i.e., there are many similar pixels (picture elements) representing homogenous materials. Because so many pixels have similar spectra, finding anomalous pixels is a non-trivial problem. Significant effort has been spent on classifying pixels in imagery. The goal of image classification is to group spectrally similar pixels together to the exclusion of anomalous pixels, i.e., separate the many from the few. Most classification methodologies do not easily lend themselves to the extraction of anomalous pixels. The reason for this is that these general classification algorithms address the relatively simple problem of analyzing the majority of the pixels. Nonetheless, it is useful to examine general classification approaches in the context of the method detailed here for anomaly detection. The goal of anomaly detection is to find pixels that are significantly different from the majority of the pixels in an image, i.e., separate the few from the many. The definition of anomalous is rather arbitrary, but it can be expressed statistically, i.e., 2 , or standard deviations, from the mean of a population with an assumed distribution, or merely as a proportion of the whole dataset, i.e., representing only \h\h1 % of the whole, etc. Local anomaly detectors generally consider only the surrounding pixels to determine the nature of a pixel and are susceptible to noise, e.g., RX anomaly detection (Yu, Reed, and Stocker, 1993; Yu, et al., 1997). Global anomaly detectors evaluate each pixel in comparison to the entire image. The global approach generally alleviates problems associated with local variations in data values. The purpose of this paper is to explore methods for finding anomalous pixels in AVIRIS imagery. Toward this end several approaches are described in detail beginning with the simplest and progressing to more complicated techniques. For completeness, a brief overview of finding anomalies using conventional supervised classification is also presented. Histograms are introduced first, followed by simple statistical measures, and concluding with the use of Self-Organizing Maps.
Derived from text
Anomalies; Detection; Earth Surface; Heterogeneity; Image Classification; Remote Sensing

44
ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*; and *28 Propellants and Fuels*.

20050188521 NASA Lewis Research Center, Cleveland, OH, USA
Inflatable Solar Thermal Concentrator Delivered
Tolbert, Carol M.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Space-based solar thermal power systems are very appealing as a space power source because they generate power efficiently. However, solar thermal (dynamic) systems currently incorporate rigid concentrators that are relatively heavy and require significant packaging volume and robust deployment schemes. In many ways, these requirements make these systems less appealing than photovoltaic systems. As an alternative to solar thermal power systems with rigid concentrators, solar thermal power systems with thin film inflation-deployed concentrators have low cost, are lightweight, and are efficiently packaged and deployed. Not only are inflatable concentrators suitable for low Earth orbit and geosynchronous orbit applications, but they can be utilized in deep space missions to concentrate solar energy to high-efficiency solar cells.
Derived from text
Solar Collectors; Solar Cells; Solar Thermal Electric Power Plants

20050189231 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
Characterization of SEI Layers on LiMn2O4 Cathodes with In situ Spectroscopic Ellipsometry
Lei, J.; Li, L.; Kostecki, R.; Muller, R.; McLarnon, F.; January 2005; 28 pp.; In English
Report No.(s): DE2005-837416; No Copyright; Avail: Department of Energy Information Bridge

In situ spectroscopic ellipsometry was employed to study the initial stage of SEI layer formation on thin-film LiMn(sub 2)O(sub 4) electrodes. It was found that the SEI layer formed immediately upon exposure of the electrode to EC/DMC (1:1 by vol) 1.0 M LiPF(sub 6) electrolyte. The SEI layer thickness then increased in proportion to a logarithmic function of elapsed time. In comparison, the SEI layer thickness on a cycled electrode increased in proportion to a linear function of the number of cycles.
NTIS
Cathodes; Ellipsometry; Spectroscopy; Thin Films; Lithium Compounds

20050192262 NASA Glenn Research Center, Cleveland, OH, USA

Nanostructured Materials Developed for Solar Cells

Bailey, Sheila G.; Castro, Stephanie L.; Raffaelle, Ryne P.; Fahey, Stephen D.; Gennett, Thomas; Tin, Padetha; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

There has been considerable investigation recently regarding the potential for the use of nanomaterials and nanostructures to increase the efficiency of photovoltaic devices. Efforts at the NASA Glenn Research Center have involved the development and use of quantum dots and carbon nanotubes to enhance inorganic and organic cell efficiencies. Theoretical results have shown that a photovoltaic device with a single intermediate band of states resulting from the introduction of quantum dots offers a potential efficiency of 63.2 percent. A recent publication extended the intermediate band theory to two intermediate bands and calculated a limiting efficiency of 71.7 percent. The enhanced efficiency results from converting photons of energy less than the band gap of the cell by an intermediate band. The intermediate band provides a mechanism for low-energy photons to excite carriers across the energy gap by a two-step process.

Derived from text

Solar Cells; Nanostructures (Devices); Solar Energy Conversion

20050192282 NASA Glenn Research Center, Cleveland, OH, USA, Ohio State Univ., OH, USA

High-Efficiency Multibandgap Solar Cell Being Developed

Wilt, David M.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Current high-efficiency solar cells are based on lattice-matched materials, specifically indium gallium phosphide (InGaP) on gallium arsenide (GaAs) on germanium (Ge). These materials were chosen more for their lattice constant (spacing between atoms) than their ability to efficiently convert the solar spectrum. Theoretical analysis indicates that the optimum efficiency for a multijunction solar cell would utilize very different bandgap cells. Unfortunately, no group of materials satisfies both the lattice-match and optimum bandgap requirements. The projected efficiency of the current state-of-the-art dual-junction InGaP/GaAs solar cell is ~29 percent (at air mass zero, AM0). If the optimum bandgaps could be utilized, the projected efficiency would increase to ~33 percent. The use of lattice-mismatched materials has been avoided because the mismatch generates performance-robbing defects. Several novel buffer-layer concepts are being developed to mitigate these problems. Under a Small Business Innovation Research contract with the NASA Glenn Research Center at Lewis Field, Essential Research is developing an optimized dual-junction, lattice-mismatched solar cell based on indium aluminum gallium phosphide (InGaAlP) on indium gallium arsenide (InGaAs). These devices are lattice matched to each other, but lattice mismatched to either GaAs or Ge substrates. A novel InGaAs buffer layer has been demonstrated that effectively reduces the deleterious effects of lattice mismatching. Current test devices have projected efficiencies of 26 percent at AM0. Three- and four-junction bandgap-optimized, lattice-mismatched solar cells are also being developed.

Derived from text

Solar Cells; Energy Gaps (Solid State)

20050192330 NASA Glenn Research Center, Cleveland, OH, USA

Nickel-Hydrogen Battery Cell Life Test Program Update for the International Space Station

Miller, Thomas B.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA and Boeing North America are responsible for constructing the electrical power system for the International Space Station (ISS), which circles the Earth every 90 minutes in a low Earth orbit (LEO). For approximately 55 minutes of this orbit, the ISS is in sunlight, and for the remaining 35 minutes, the ISS is in the Earth s shadow (eclipse). The electrical power system must not only provide power during the sunlight portion by means of the solar arrays, but also store energy for use during the eclipse. Nickel-hydrogen (Ni/H2) battery cells were selected as the energy storage systems for ISS. Each battery Orbital Replacement Unit (ORU) comprises 38 individual series-connected Ni/H2 battery cells, and there are 48 battery ORU s on the ISS. On the basis of a limited Ni/H2 LEO data base on life and performance characteristics, the NASA Glenn Research Center at Lewis Field commenced testing through two test programs: one in-house and one at the Naval Surface Warfare Center in Crane, Indiana.

Derived from text

Nickel Hydrogen Batteries; International Space Station; Energy Storage

20050192342 NASA Glenn Research Center, Cleveland, OH, USA

High-Temperature Superconductive Cabling Investigated for Space Solar Power Satellites

Tew, Roy C.; Juhasz, Albert J.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA has been directed by Congress to take a fresh look at the Space Solar Power (SSP) concept that was studied by the Department of Energy and NASA about 20 years ago. To summarize, the concept involves (1) collecting solar energy and converting it to electrical energy via photovoltaic arrays on satellites in Earth orbit, (2) conducting the electricity to the microwave transmitting portion of the satellite, and (3) transmitting the power via microwave transmitters (or possibly via lasers) to ground power station antennas located on the surface of the Earth. One Sun Tower SSP satellite concept is illustrated here. This figure shows many photovoltaic arrays attached to a 'backbone' that conducts electricity down to a wireless transmitter, which is pointed toward the Earth. Other variations on this concept use multiple backbones to reduce the overall length of the satellite structure. In addition, non-Sun-Tower concepts are being considered. The objective of the work reported here was to determine the benefits to the SSP concept of using high-temperature superconductors (HTS) to conduct the electricity from the photovoltaic arrays to the wireless power transmitters. Possible benefits are, for example, reduced mass, improved efficiency, and improved reliability. Dr. James Powell of Plus Ultra Technologies, Inc., of Stony Brook, New York, is conducting the study, and it is being managed by the NASA Glenn Research Center at Lewis Field via a task-order contract through Scientific Applications International Corp. (SAIC).
Author
High Temperature Superconductors; Solar Power Satellites; Solar Arrays; Artificial Satellites; Photovoltaic Cells; Solar Energy Conversion

20050192423 NASA Glenn Research Center, Cleveland, OH, USA
Regenerative Fuel Cell Test Rig Completed and Operational at Glenn Research Center
Bents, David J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy
The NASA Glenn Research Center has completed construction of its first closed-cycle hydrogen-oxygen regenerative fuel cell (RFC). The RFC is an electrochemical system that collects and stores solar energy during the day then releases that energy at night, thus making the Sun's energy available all 24 hours. It consists of a dedicated hydrogen-oxygen fuel cell stack and an electrolyzer stack, the interconnecting plumbing and valves, cooling pumps, water transfer pumps, gas recirculation pumps, phase separators, storage tanks for oxygen (O2) and hydrogen (H2), heat exchangers, isolation valves, pressure regulators, nitrogen purge provisions, instrumentation, and other components. It includes all the equipment required to (1) absorb electrical power from an outside source and store it as pressurized hydrogen and oxygen and (2) make electrical power from the stored gases, saving the product water for reuse during the next cycle.
Derived from text
Regenerative Fuel Cells; Solar Energy; Fuel Cells

45
ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20050186909 Illinois Univ. at Urbana-Champaign, Urbana, IL, USA
Parametric Analyses of Potential Effects on Upper Tropospheric/Lower Stratospheric Ozone Chemistry by a Future Fleet of High Speed Civil Transport (HSCT) Type Aircraft
Dutta, Mayurakshi; Patten, Kenneth O.; Wuebbles,Donald J.; June 2005; 36 pp.; In English
Contract(s)/Grant(s): NAS3-03091; WBS 22-714-20-25
Report No.(s): NASA/CR-2005-213646; E-15134; No Copyright; Avail: CASI; A03, Hardcopy
This report analyzed the potential impact of projected fleets of HSCT aircraft (currently not under development) through a series of parametric analyses that examine the envelope of potential effects on ozone over a range of total fuel burns, emission indices of nitrogen oxides, and cruise altitudes.
Author
Stratosphere; Supersonic Transports; Atmospheric Composition; Civil Aviation; Ozone Depletion

20050187046 Energy and Environmental Research Corp., Irvine, CA, USA
Development of Fine Particulate Emission Factors and Speciation Profiles for Oil and Gas-Fired Combustion Systems. Annual Report, September 7, 2000-September 6, 2001
England, G. C.; Wien, S.; Chang, M. O.; Aug. 2002; 82 pp.; In English
Report No.(s): DE2005-836815; No Copyright; Avail: Department of Energy Information Bridge
This report provides results from the first year of this three-year project to develop dilution measurement technology for

characterizing PM2.5 (particles with aerodynamic diameter smaller than 2.5 micrometers) and precursor emissions from stationary combustion sources used in oil, gas and power generation operations. Detailed emission rate and chemical speciation test results for a refinery gas-fired process heater and plans for cogeneration gas turbine tests and pilot-scale tests are presented. Tests were performed using a research dilution sampling apparatus and traditional EPA methods to compare PM2.5 mass and chemical speciation. Test plans are presented for a gas turbine facility that will be tested in the fourth quarter of 2002. A preliminary approach for pilot-scale tests is presented that will help define design constraints for a new dilution sampler design that is smaller, lighter, and less costly to use.
NTIS
Air Pollution; Combustion; Electric Generators; Furnaces; Monitors; Oils; Particulates

20050187047 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA USA
Worker Productivity and Ventilation Rate in a Call Center: Analyses of Time Series Data for a Group of Registered Nurses
Fisk, W. J.; Price, P.; Faulkner, D.; Sullivan, D.; Dibartolomeo, D.; Aug. 2003; 26 pp.; In English
Report No.(s): DE2005-836796; LBNL-53785; No Copyright; Avail: Department of Energy Information Bridge
We investigated the relationship of ventilation rates with the performance of advice nurses working in a call center. Ventilation rates were manipulated; temperatures, humidities, and CO(sub 2) concentrations were monitored; and worker performance data, with 30-minute resolution, were collected. Multivariate linear regression was used to investigate the association of worker performance with indoor minus outdoor CO(sub 2) concentration (which increases with decreasing ventilation rate per worker) and with building ventilation rate. Results suggest that the effect of ventilation rate on worker performance in this call center was very small (probably less than 1%) or nil, over most of the range of ventilation rate (roughly 12 L s(sup -1) to 48 L s(sup -1) per person). However, there is some evidence of worker performance improvements of 2% or more when the indoor CO(sub 2) concentration exceeded the outdoor concentration by less than 75 ppm.
NTIS
Air Flow; Carbon Dioxide; Medical Personnel; Productivity; Time Series Analysis

20050187049 Texas Natural Resource Conservation Commission, Austin, TX, USA
Inspection Preparation Guidelines for Chemical, Petrochemical, and Refining Facilities. Air Program Inspector's Manual
Jan. 1994; 30 pp.; In English
Report No.(s): PB2005-107771; RG-31B; No Copyright; Avail: CASI; A03, Hardcopy
This document describes the air program inspector's manual. It includes the inspection preparation guidelines.
NTIS
Air Pollution; Crude Oil; Inspection; Manuals; Pollution Control; Refining

20050187050 Environmental Protection Agency, Washington, DC, USA
Tools of the Trade: A Guide to Designing and Operating a Cap and Trade Program for Pollution Control
Jun. 2003; 82 pp.; In English
Report No.(s): PB2005-108065; EPA-430-B-03-002; No Copyright; Avail: CASI; A05, Hardcopy
This guidebook is intended as a reference for policy-makers and regulators considering cap and trade as a policy tool to control pollution. It is intended to be sufficiently generic to apply to various pollutants and environmental concerns; however, it emphasizes cap and trade to control emissions produced from stationary source combustion. In the USA, sulfur dioxide and nitrogen oxide are controlled with cap and trade programs. These programs provide many illustrative examples that are described within this text.
NTIS
Environment Protection; Pollution Control

20050187053 Sierra Research, Inc., Sacramento, CA, USA
Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data
Feb. 2000; 162 pp.; In English
Contract(s)/Grant(s): EPA-68-C7-0051
Report No.(s): PB2005-106972; No Copyright; Avail: CASI; A08, Hardcopy
;Table of Contents: Introduction; Review of Relevant Data; Emission Factor Development; Marine Vessel Classifications

and Power Ratings; Emission Factor Summary; References; Appendix A: Emission Factor Regression Summaries; Appendix B: Summary of Reports Reviewed; Appendix C: Acurex Classification of Shiptypes; List of Tables and List of Figures.
NTIS
Fuel Consumption; Inventories; Marine Transportation; Transportation

20050187067 Texas Commission on Environmental Quality, Austin, TX, USA
Texas Emissions Reduction Plan: Biennial Report to the Texas Legislature, December 2004
Dec. 2004; 92 pp.; In English
Report No.(s): PB2005-107707; SFR-079/04; No Copyright; Avail: CASI; A05, Hardcopy

The Texas Commission on Environmental Quality (TCEQ) is pleased to provide the second biennial report in fulfillment of the requirements of Sections 386.057, 386.116(d), and 387.010 of the Texas Health and Safety Code. The first report was submitted in December 2002. The Texas Emissions Reduction Plan (TERP) was established by the 77th Texas Legislature in 2001, through enactment of Senate Bill (SB) 5 to help improve and maintain good air quality in areas throughout the State. In 2003, House Bill (HB) 1365 was enacted and: established a new revenue source of vehicle title fee increases under Sections 501.138(a) and (b) of the Transportation Code to replace the $225 out-of-state vehicle registration fee determined to be unconstitutional. In addition, under Section 151.0515 of the Tax Code the existing surcharge on the sale, lease, or rental of new or used off-road equipment increased from 1 to 2 percent and a 1 percent surcharge was added for the sale, lease, or use of model year 1997 and later heavy-duty diesel on-road vehicles under 152.0215(a) of the Tax Code; added a small business grants program; and, increased the number of eligible counties and the types of eligible projects for the Emissions Reduction Incentive and Small Business Grants Programs.
NTIS
Air Pollution; Air Quality; Management Planning

20050187117 ARCADIS Geraghty and Miller, Inc., Mountain View, CA, USA
Commercial Marine Activity for Great Lake and Inland River Ports in the USA
Browning, L.; Genovesi, K.; Sep. 1999; 88 pp.; In English
Contract(s)/Grant(s): EPA-68-C6-0068
Report No.(s): PB2005-106982; No Copyright; Avail: CASI; A05, Hardcopy

This report is Volume II of a two volume report on commercial marine activity in the USA developed by ARCADIS Geraghty & Miller, Inc., for the U.S. Environmental Protection Agency (EPA), Office of Mobile Sources. This Volume addresses commercial marine activity at selected Great Lake and river ports. The purpose of this report is to present a basis for quantifying and qualifying operational characteristics of commercial marine activity at major Great Lake and river ports in the U.S. This report details work performed under work assignment (WA) 2-01, a continuation of WAs 0-06 and 1-05, of Contract 68-C6-0068, begun in fiscal year 1997 by ARCADIS Geraghty & Miller for the EPA. The activity profiles developed herein may be used to quantify emissions from Great Lake and river ports in the USA. This report will help EPA to assist state and local air pollution control agencies in forming a more precise picture of commercial marine activity at Great Lake and river ports, a large contribution to overall marine activity, and may help in devising incentive programs and regulations to reduce emissions from the marine sector. This report will help EPA to assist state and local air pollution control agencies in forming a more precise picture of commercial marine activity at Great Lake and river ports, a large contribution to overall marine activity, and may help in devising incentive programs and regulations to reduce emissions from the marine sector.
NTIS
Air Pollution; Air Quality; Lakes; Marine Transportation; Pollution Control; Rivers; United States

20050188444 ARCADIS Geraghty and Miller, Inc., Mountain View, CA, USA
Commercial Marine Activity for Deep Sea Ports in the USA
Browning, L.; Genovesi, K.; Hill, P.; Popek, D.; Sep. 1999; 218 pp.; In English
Contract(s)/Grant(s): EPA-68-C6-0068
Report No.(s): PB2005-106983; No Copyright; Avail: CASI; A10, Hardcopy

This report is Volume I of a two volume report on commercial marine activity in the USA developed by ARCADIS Geraghty & Miller, Inc., for the U.S. Environmental Protection Agency (EPA), Office of Mobile Sources. The purpose of this report is to present a basis for quantifying and qualifying operational characteristics of commercial marine activity at major Great Lake and river ports in the U.S. This report details work performed under work assignment (WA) 2-01, a continuation of WAs 0-06 and 1-05, of Contract 68-C6-0068, begun in fiscal year 1997 by ARCADIS Geraghty & Miller for the EPA. This

report will help EPA to assist state and local air pollution control agencies in forming a more precise picture of commercial marine activity at Great Lake and river ports, a large contribution to overall marine activity, and may help in devising incentive programs and regulations to reduce emissions from the marine sector.
NTIS
Air Pollution; Air Quality; Pollution Control; United States

20050189222 Association of State Correctional Administrators, South Salem, NY, USA, Michigan Technological Univ., Houghton, MI, USA
Separation of Flue-Gas Scrubber Sludge into Marketable Products. Quarterly Report December 1, 1997-February 28, 1998
January 2005; 16 pp.; In English
Report No.(s): DE2005-16801; No Copyright; Avail: Department of Energy Information Bridge
The reduction of sulfur oxides from high sulfur coal burning utility companies has resulted in the production of huge quantities of wet flue-gas desulfurization scrubber sludge. A typical 400 MW power station burning a coal containing 3.5% sulfur by weight and using a limestone absorbent would produce approximately 177,000 tons (dry weight) of scrubber sludge per year. This brownish colored, finely divided material contains calcium sulfite (CaSO(sub 3) (center-dot) 1/2 H(sub 2)O), calcium sulfate (CaSO(sub 4) (center-dot) 2H(sub 2)O), unreacted limestone (CaCO(sub 3)), and various other impurities such as fly-ash and iron oxide particles. The physical separation of the components of scrubber sludge would result in the re-use of this material. The primary use would be conversion to a highly pure synthetic gypsum. This technical report concentrates on the effect of baffle configuration on the separation of calcium sulfite/sulfate from limestone. The position of the baffles as they related to the feed inlet, and the quantity of the baffles were examined. A clean calcium sulfite/sulfate (less than 2.0% limestone by weight) was achieved with the combination of water-only cyclone and horizontally baffled column.
NTIS
Baffles; Flue Gases; Scrubbers; Sludge

20050189237 Iowa State Univ. of Science and Technology, Ames, IA, USA
Improving Efficiency of a Counter-Current Flow Moving Bed Granular Filter
Colver, G. M.; Brown, R. C.; Shi, H.; Saw-Choon Soo, D.; January 2004; 18 pp.; In English
Report No.(s): DE2005-835846; No Copyright; Avail: Department of Energy Information Bridge
The goal of this research is to improve the performance of moving bed granular filters for gas cleaning at high temperatures and pressures. A second goal of the research is to optimize the performances of both solids and gas filtering processes through appropriate use of granular bed materials, particle sizes, feed rates etc. in a factorial study. These goals are directed toward applications of advanced coal-fired power cycles under development by the U.S. Department of Energy including pressurized fluidized bed combustion and integrated gasification/combined cycles based on gas turbines and fuel cells. Only results for particulate gas cleaning are reported here.
NTIS
Cleaning; Energy Conversion; High Temperature Gases

20050189255 Inst. for Research and Technical Assistance, Glendale, AZ, USA
Alternatives to Automotive Consumer Products That Use Volatile Organic Compounds (VOC) and/or Chlorinated Organic Compound Solvents. Addendum
Zavadil, J.; Morris, M.; Wolf, D.; Dec. 2004; 290 pp.; In English
Contract(s)/Grant(s): ARB-01-317
Report No.(s): PB2005-107402; No Copyright; Avail: CASI; A13, Hardcopy
This addendum to the document entitled 'Alternatives to Automotive Consumer Products that use Volatile Organic Compounds (VOC) and/or Chlorinated Organic Compound Solvents' presents the questionnaires that were filled out by the staff of the Institute for Research and Technical Assistance (IRTA) during the project. IRTA recruited 13 auto repair facilities, three automotive detailers, one car wash and three consumers to test and evaluate the alternative low-VOC alternatives developed in the course of the project. IRTA generally provided samples of the alternatives to the facilities and monitored the testing on a weekly basis. The questionnaires were filled out by IRTA staff when the facilities or individuals had completed testing of each alternative. In a few cases, facility personnel filled out the questionnaires themselves. This addendum provides the raw data questionnaires in the following order: Engine Degreasing Questionnaires--based on feedback from the three automotive detailers, one car wash and three consumers on the alternative engine degreasers; Carburetor and Fuel Injection

System Cleaning Questionnaires--based on feedback from the 13 auto repair facilities; and Brake Cleaning and General Purpose Degreasing Questionnaires--based on feedback from the 13 auto repair facilities.
NTIS
Air Pollution; Alternatives; Automobiles; Chlorination; Cleaners; Consumers; Organic Compounds; Pollution Control; Solvents; Volatile Organic Compounds

20050192043 Department of Energy, Washington, DC USA
International Technical Support and Assistance for Joint Implementation and other Supporting Mechanisms and Measures for Greenhouse Gas Emissions Mitigation
Sep. 2002; 16 pp.; In English
Report No.(s): DE2005-821086; No Copyright; Avail: Department of Energy Information Bridge
Under the cooperative agreement for 'International Technical Support and Assistance for Joint Implementation and other Supporting Mechanisms and Measures for Greenhouse Gas Emissions Mitigation projects,' the Center for Clean Air Policy (CCAP) team has been providing the Department of Energy (DOE) with technical expertise and assistance to enable developing countries to take steps towards meaningful participation in a global effort to reduce emissions of greenhouse gases. This report summaries activities completed under this cooperative agreement.
NTIS
Developing Nations; Exhaust Emission; Exhaust Gases; Greenhouse Effect; International Cooperation

20050192050 CVI, Inc., Columbus, OH, USA
Final Report on the Development of a Liquid to Compressed Natural Gas (LCNG) Fueling Station
Jan. 30, 1999; 32 pp.; In English
Report No.(s): DE2005-824059; No Copyright; Avail: Department of Energy Information Bridge
This program had as its objective the development and demonstration of equipment and processes to produce compressed natural gas (CNG) from liquefied natural gas (LNG) for heavy duty vehicular applications. The interest for this technology is a result of the increased use of alternative fuels for the reduction of emissions and dependency on foreign energy. An abundant source of natural gas is available in the USA. Technology of the type developed under this program is critical for establishing natural gas as an economical alternative fuel.
NTIS
Compressed Gas; Liquefied Natural Gas; Natural Gas; Refueling; Substitutes

20050192053 Department of Energy, Washington, DC USA
In-Situ Electrolyte Replenishment for Long Fuel Cell Life
January 2005; 20 pp.; In English
Report No.(s): DE2005-824074; No Copyright; Avail: Department of Energy Information Bridge
The carbonate fuel cell has many advantages over conventional methods of producing electricity. It converts hydrocarbon fuels directly into electricity with a high efficiency (\g70% in a cogeneration plant configuration) and consequently releases less carbon dioxide greenhouse gases (\g30% less compared to a combined cycle gas turbine plant). Its adaptability to meet the customers' specific power requirements is ideally suited for distributed power generation. Several electrolyte-related issues in the present design impose limitations on fuel cell life. This research effort has focused on four major strategies to reduce electrolyte loss and increase electrolyte inventory: - In-situ electrolyte replenishment within the cell by storing an electrolyte in the cathode gas chamber. The electrolyte is a solid at the operating temperatures but slowly absorbs into the cell over time. An added benefit of this design is it alters the electrolyte composition making it lithium-rich, which reduces electrolyte vaporization loss. - Development of a novel cathode design having ribs to replace the baseline metallic cathode current collector. The current collector is responsible for significant electrolyte loss because when it corrodes it consumes lithium carbonate electrolyte. An added benefit of this design is it provides significant additional electrolyte storage space. - Identification of a more corrosion-resistant material or coating for the cathode current collector to reduce electrolyte losses. - Development of methods to reduce electrolyte migration, which depletes electrolyte from the positive end-cells of a stack.
NTIS
Carbonates; Electricity; Electrolytes; Fuel Cells; Replenishment

20050192066 California Univ., Riverside, CA, USA
Evaluation of Atmospheric Impacts of Selected Coatings VOC Emissions
Carter, W. P.; Malkina, I. L.; Mar. 2005; 158 pp.; In English
Contract(s)/Grant(s): CARB-00-333
Report No.(s): PB2005-106560; No Copyright; Avail: CASI; A08, Hardcopy

An experimental and modeling study was carried out to reduce uncertainties in atmospheric ozone impacts of architectural coatings VOCs. The focus of this project was Texanol (isobutyrate monoesters of 2,2,4-trimethyl-1,3-pentanediol), which is widely used in water-based coatings, and various hydrocarbon solvents representative of those used in solvent-based coatings. The hydrocarbon 'bin' reactivity assignments developed by the CARB for hydrocarbon solvents were evaluated using compositional data from 124 different solvents, and a new methodology was developed for deriving such assignments that can be used when reactivity scales are updated or modified. Progress was made towards developing a direct reactivity measurement method that does not require gas chromatographic analyses, but additional work is needed before data can be obtained for solvents of interest. Environmental chamber experiments were carried out to evaluate the abilities of mechanisms of Texanol and six different types of hydrocarbon solvents to predict their atmospheric ozone impacts, and comparable experiments were carried out with m-xylene and n-octane for control and comparison purposes.
NTIS
Air Pollution; Volatile Organic Compounds; Coatings

20050192067 Pennsylvania State Univ., University Park, PA, USA
Indoor Environment Design Tool for Entire Buildings
Srebric, J.; January 2005; 10 pp.; In English
Report No.(s): PB2005-106845; No Copyright; Avail: CASI; A02, Hardcopy

The main project aim was to develop an integrated design tool to analyze combined problems of Indoor Air Quality (IAQ) and thermal comfort for an entire building. The orignial aim has not been changed. The main success of the project is that the integrated tool is developed and that it was used for several case studies. The tool was validated with on site-data, a step that no other study in this area has ever performed before. Further improvements of the integrated tool should be made to sustain the project's long term vision of having this technology readily available in building design industry.
NTIS
Buildings; Indoor Air Pollution

20050192305 Inst. for Research and Technical Assistance, Glendale, AZ, USA
Alternatives to Automotive Consumer Products That Use Volatile Organic Compounds (VOC) and/or Chlorinated Organic Compound Solvents
Zavadil, J.; Wolf, D.; Morris, M.; Dec. 2004; 180 pp.; In English
Contract(s)/Grant(s): CARB-01-317
Report No.(s): PB2005-107401; No Copyright; Avail: CASI; A09, Hardcopy

This project involved developing, testing and demonstrating alternative near-zero VOC automotive aerosol products for engine degreasing, carburetor and fuel injection system cleaning, brake cleaning and general purpose degreasing. The products were tested with technicians in 13 auto repair facilities, one car wash, three detailers and with three consumers. Eight water-based cleaners that performed well for engine degreasing were identified and tested. The VOC content of most of these cleaners was 10%. Three alternative soy/acetone blends that performed very well for carburetor and fuel injection system cleaning were identified and tested. The VOC content of these cleaners was near-zero. Three water-based cleaners and two soy/acetone blends that performed well for brake cleaning and/or general purpose degreasing were identified and tested.
NTIS
Air Pollution; Alternatives; Automobiles; Chlorination; Cleaners; Consumers; Organic Compounds; Pollution Control; Solvents; Volatile Organic Compounds

20050192356 4th Wave Imaging Corp., Aliso Viejo, CA, USA
Time-Lapse Modeling and Inversion of CO2 Saturation for Sequestration and Enhanced Oil Recovery. Quarterly Report for the Period July 1, 2004-September, 30, 2004
Meadows, M. A.; Nov. 19, 2004; 10 pp.; In English
Report No.(s): DE2005-836198; No Copyright; Avail: Department of Energy Information Bridge

In the fourth quarter of this DOE NETL project, they have developed an algorithm for generating time-lapse seismic

anomalies from changes in fluid properties over time. This forward-modeling algorithm constitutes the first step in the inversion procedure of Phase III of the project. Examples were generated illustrating the flexibility of this approach. Additional activities in this reporting period included a trip by the Principal Investigator to the 7th International Conference on Greenhouse Gas Control Technologies (GHGT-7) in Vancouver, Canada, September 5-9, 2004. In the next quarter, they will work on the second step of the inversion procedure, namely, the inversion of the seismic time-lapse anomalies to obtain changes in fluid properties, and will continue investigating alternative methods for calculating properties of oil/brine/CO(sub 2) and brine/CO(sub 2) systems.
NTIS
Carbon Dioxide; Inversions; Oil Recovery

46
GEOPHYSICS

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

20050187041 State Univ. of New York, Buffalo, NY, USA
Experimental and Analytical Studies of Structures Seismically Isolated with an Uplift-Restraint Isolation System
Roussis, P. C.; Constantinou, M. C.; Jan. 10, 2005; 390 pp.; In English
Report No.(s): PB2005-108222; No Copyright; Avail: CASI; A17, Hardcopy

This report describes the development of a novel uplift-prevention Friction Pendulum isolator called the XY-FP. It presents the principles of operation and mathematical model of the XP-FP isolator, describes its mechanical behavior through testing of a single isolator, and demonstrates its effectiveness through testing of a quarter-scale steel-frame model structure. The computer program 3D-BASIS-ME was modified to include an element representative of the mechanical behavior of the new XY-FP isolator, and the validity and accuracy of analytical methods to predict its behavior is assessed. The study shows that the XY-FP isolator provides effective uplift prevention regardless of the state of displacement in the bearing, allows for decoupling of the bi-directional horizontal motion along two orthogonal directions, and has the capability to provide distinct stiffness and energy dissipation along the principal directions of the bearing. In addition, by encompassing much less structural material, the isolator offers a lighter and more economical alternative to the standard Friction Pendulum bearing. Moreover, it provides an architecturally flexible solution in terms of integration into a structural system when space considerations are important.
NTIS
Constraints; Isolation; Isolators; Prevention

20050192455 Tel-Aviv Univ., Ramat-Aviv, Tel-Aviv, Israel
Assessment of Soil Erosion Potential in Semi-Arid Soils Using Hyperspectral Technology
Ben-Dor, E.; Goldshalager, N.; Braun, O.; Kindel, B.; Goetz, A. F. H.; Bonfil, D.; Agassi, M.; Binyaminy, Y.; Karnieli, A.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 11 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Soil erosion by water runoff is a matter of great concern in both bare and agricultural lands. This process may lead to significant effects, such as water lost to the soil profile, decline in soil fertility and productivity, and increased peak stream flow, as well as associated floods. The main cause of the runoff from rain and overhead irrigation water is the structural crust that develops over bare soils during rainfall or irrigation events that significantly reduces the soils infiltration rate. The hydraulic conductivity of this crust is a few orders of magnitude lower than that of the underlying soil (e.g., McIntyre, 1958; Morin and Benyamini, 1977). Whenever the hydraulic conductivity of the crust is lower than the rainfall intensity, ponding, runoff and soil erosion will occur. Most of the available methods for assessing the physical crust status use disturbed soil samples that do not represent exact field conditions (Keren and Singer, 1989, 1991) or use simulation techniques that cannot mirror exact field conditions (Agassi and Bradford, 1999). Consequently, mapping and predicting soil structural crust processes are of great interest and importance to soil scientists and farmers. Apparently, crust potential mapping is not a straightforward problem, and to the best of our knowledge, this technique has never been conducted. Recent studies by Goldshalager et al. (2001, 2002) and Ben-Dor et al. (2003), showed significant relationship existed between selected wavelengths readings and infiltration rates, when measured under controlled laboratory conditions. Further, they were able to

create a spectral library that contains spectra of three soils from Israel, in varying rain energies and crust position, and to show that a different correlation existed for each soil.
Derived from text
Soil Erosion; Soil Sampling; Irrigation; Infiltration; Arid Lands; Drainage; Soil Mapping

20050192458 Arizona Univ., Tucson, AZ, USA
The Use 0f AVIRIS Imagery To Assess Clay Mineralogy And Debris-Flow Potential In Cataract Canyon, Utah: A Preliminary Report
Rudd, Lawrence; Merenyi, Erzsebet; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 10 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NAG5-9293; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Worldwide debris flows destroy property and take human lives every year (Costa, 1984). As a result of extensive property damage and loss of life there is a pressing need to go beyond just describing the nature and extent of debris flows as they occur. Most of the research into debris-flow initiation has centered on rainfall, slope angle, and existing debris-flow deposits (Costa and Wieczorek, 1987). The factor of source lithology has been recently addressed by studies in the sedimentary terranes of Grand Canyon (Webb et al., 1996; Griffiths et al., 1996) and on the Colorado Plateau as a whole.3 On the Colorado Plateau shales dominated by kaolinite and illite clays are significantly more likely to be recent producers of debris-flows than are shales in which smectite clays dominate.3 Establishing the location of shales and colluvial deposits containing kaolinite and illite clays in sedimentary terranes on the Colorado Plateau is essential to predicting where debris flows are likely to occur. AVIRIS imagery can be used to distinguish between types of clay minerals (Chabrillat et al., 2001), providing the basis for surface-materials maps. The ultimate product of this study will be a model that can be used to estimate the debris-flow hazard in Cataract Canyon, Utah. This model will be based on GIS overlay analysis of debris-flow initiation factor maps, including surface-materials maps derived from AVIRIS data.
Derived from text
Clays; Surface Properties; Mineralogy; Debris; Lithology; Kaolinite; Hazards; Damage

20050192460 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Volcanic CO2 Abundance of Kilauea Plume Retrieved by Meand of AVIRIS Data
Spinetti, C.; Carrere, V.; Buongiorno, M. F.; Pieri, D.; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Absorbing the electromagnetic radiation in several regions of the solar spectrum, CO2 plays an important role in the Earth radiation budget since it produces the greenhouse effect. Many natural processes in the Earth s system add and remove carbon dioxide. Overall, measurements of atmospheric carbon dioxide at different sites around the world show an increased carbon dioxide concentration in the atmosphere. At Mauna Loa Observatory (Hawaii) the measured carbon dioxide increased from 315 to 365 ppm, in the period 1958 2000 [Keeling et al., 2001]. While at the large scale, the relationship between CO2 increase and global warming is established [IPCC, 1996], at the local scale, many studies are still needed to understand regional and local sources of carbon dioxide, such as volcanoes. The volcanic areas are particularly rich in carbon dioxide; this is due to magma degassing in the summit craters region of active volcanoes, and to the presence of fractures and active faults [Giammanco et al., 1998]. Several studies estimate a global flux of volcanic CO2 (34+/-24)10(exp 6) tons/day from effusive volcanic emissions, such as the tropospheric volcanic plume (Table 1) [McClelland et al., 1989]. Plumes are a turbulent mixture of gases, solid particles and liquid droplets, emitted continuously at high temperature from summit craters, fumarolic fields or during eruptive episodes. Inside the plume, water vapour represents 70 90% of the volcanic gases. The main gaseous components are CO2, SO2, HCl, H2, H2S, HF, CO, N2 and CH4. Other plume components are volcanic ash, aqueous and acid droplets and solid sulphur-derived particles [Sparks et al., 1997]. Volcanic gases and aerosols are evidences of volcanic activity [Spinetti et al., 2003] and they have important climatic and environmental effects [Fiocco et al., 1994]. For example, Etna volcano is one of the world s major volcanic gas sources [Allard et al., 1991]. New studies on volcanic gaseous emissions have pointed out that a variation of the gas ratio CO2/SO2 is related to eruptive episodes [Caltabiano et al., 1994]. However, measurements and monitoring of volcanic carbon dioxide are difficult and often hazardous, due to the high background presence of atmospheric CO2 and the inaccessibility of volcanic sites. Hyperspectral remote sensing is a suitable technique to overcome the difficulties of ground measurement. It permits a rapid, comprehensive view of volcanic plumes and their evolution over time, detection of all gases with absorption molecular lines within the sensor s multispectral range and, in general, measurement of all the volatile components evolving from craters. The molecular and particle plume components

scatter and absorb incident solar radiation. The integral of the radiation difference composes the signal measured by the remote spectrometer. The inversion technique consists of retrieving the plume component concentrations, hence decomposing the signal into the different contributions. The accuracy of remote sensing techniques depends primarily on the sensor capability and sensitivity.
Derived from text
Electromagnetic Radiation; Solar Spectra; Solar Radiation; Plumes; Volcanoes; Carbon Dioxide; Decomposition

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20050187051 National Centers for Environmental Prediction, Silver Spring, MD USA
Blizzard of '96, January 6-8, 1996. Service Assessment
Dec. 1996; 58 pp.; In English
Report No.(s): PB2005-108216; No Copyright; Avail: CASI; A04, Hardcopy

January 6-8, 1996, a major 'nor'easter' paralyzed the Eastern Seaboard for the better part of a week. Right on the heels of a Federal Government shutdown that furloughed most Federal employees, some of the heaviest snow of the late 20th century blanketed the highly populated urban corridor from Washington, D.C., to Boston, Massachusetts. The facts contained in this report speak for themselves concerning the quality of service that both the National Weather Service (NWS) and all of our partners in the hazards community provided to the public. Many NWS employees were stranded at or near the office for several days, working long hours and sleeping either on-site or at nearby hotels. A few risked their lives to get to work. Local emergency managers across the affected area commended local NWS offices for timely and accurate warnings, watches, and outlooks. Rigorous continuing coordination between NWS field offices, local emergency managers, and the media months in advance of the event ensured that clear lines of communication were already in place when the storm struck. The final result was that the warning system worked, enabling the public, local decision makers, and all weather sensitive interests to take timely actions to reduce the threats to life and property.
NTIS
Snowstorms; Coordination; Snow; Warning Systems

20050187052 Texas A&M Univ., College Station, TX USA
Deepwater Physical Oceanography Reanalysis and Synthesis of Historical Data (Raw Data on CD-ROM)
Aug. 2001; In English
Report No.(s): PB2005-500034; OCS-MMS-GM-97-0042; No Copyright; Avail: National Technical Information Service (NTIS)

This report summarizes work to assemble historical physical oceanographic data, including hydrographic data, current measurements and drifting buoy trajectories; to process data for quality control; to identify and prioritize physical processes and phenomena operating in the deepwater Gulf of Mexico; and to develop recommendations for experimental designs for future field studies. Ten processes were prioritized as requiring additional study. In order of priority, they are: deep barotropic and bottom-intensified motions, general circulation deep currents, currents associated with furrows, eddy induces currents, Loop Current, general circulation surface currents subsurface mid-water column motions hurricane/tropical cyclone induced motions, other energetic wind event induced motions and topographically generated near-inertial motions. Four Specific measurement programs were recommended to measure the top three priority processes. Six suggestions were made for systematic monitoring operations, including enhancing measurements made on drill ships and production platforms of the petroleum industry. Model comparisons and improved boundary conditions were suggested to enhance numerical modeling in the deepwater Gulf.
NTIS
CD-ROM; Gulf of Mexico; Histories; Minerals; Multimission Modular Spacecraft; Ocean Dynamics; Oceanography; Water Depth

20050187080 Maryland Univ., College Park, MD, USA, Florida State Univ., Tallahassee, FL, USA
Study of Longwave Radiation Codes for Climate Studies: Validation with ARM Observations and Tests in General Circulation Models. Final Report
Ellingson, R. G.; January 2005; 20 pp.; In English
Report No.(s): DE2005-832723; No Copyright; Avail: Department of Energy Information Bridge

One specific goal of the Atmospheric Radiation Measurements (ARM) program is to improve the treatment of radiative transfer in General Circulation Models (GCMs) under clear-sky, general overcast and broken cloud conditions. Our project was geared to contribute to this goal by attacking major problems associated with one of the dominant radiation components of the problem --longwave radiation. The primary long-term project objectives were to: (1) develop an optimum longwave radiation model for use in GCMs that has been calibrated with state-of-the-art observations for clear and cloudy conditions, and (2) determine how the longwave radiative forcing with an improved algorithm contributes relatively in a GCM when compared to shortwave radiative forcing, sensible heating, thermal advection and convection. The approach has been to build upon existing models in an iterative, predictive fashion. We focused on comparing calculations from a set of models with operationally observed data for clear, overcast and broken cloud conditions. The differences found through the comparisons and physical insights have been used to develop new models, most of which have been tested with new data. Our initial GCM studies used existing GCMs to study the climate model-radiation sensitivity problem. Although this portion of our initial plans was curtailed midway through the project, we anticipate that the eventual outcome of this approach will provide both a better longwave radiative forcing algorithm and from our better understanding of how longwave radiative forcing influences the model equilibrium climate, how improvements in climate prediction using this algorithm can be achieved.
NTIS
Atmospheric General Circulation Models; Climate; Climate Models; Long Wave Radiation

20050189157 Naval Research Lab., Bay Saint Louis, MS USA
Hurricane Isabel: A Numerical Model Study of Storm Surge Along the East Coast of the USA
Preller, Ruth H.; Posey, Pamela G.; Dawson, Gretchen M.; Jan. 2003; 14 pp.; In English
Report No.(s): AD-A434316; NRL/PP/7320--04-5010; No Copyright; Avail: CASI; A03, Hardcopy

On the 6th of September 2003, a westward moving tropical wave in the far eastern Atlantic began to organize and evolve into tropical storm Isabel. By September 7, Isabel had become a full-fledged hurricane and began to move west-northwest. Isabel continued her northwest track through the 8th and 9th, intensifying into a major hurricane. By September 11th, Isabel had become a Category 5 hurricane on the Saffir-Simpson Scale, and maintained this high level of intensity through September 15th. During this time Isabel took a more westward track, until it began to turn northwestward on the 15th. On the 16th, Isabel began to weaken and headed in a north-northwestward direction toward the North Carolina coast. On September 18th, at approximately 17Z, Isabel made landfall near Drum Point, North Carolina as a Category 2 hurricane with sustained winds near 100 mph and a minimum central pressure of 957 mb. Hurricane forecast winds extended 115 miles from the center of its eye with tropical storm force winds extending 345 miles out from the center. By 1500Z (11 am EDT) on September 19th, Isabel was downgraded to a tropical depression located northeast of Cleveland, Ohio and was moving rapidly to the north. Numerical ocean models can be used to both forecast and hindcast storm surge events. These models use the wind and pressure forcing associated with a hurricane or tropical storm to associated storm surge.
DTIC
Coasts; Cyclones; Hurricanes; Mathematical Models; Storm Surges; Storms; Tropical Storms; United States

20050189269 Lawrence Livermore National Lab., Livermore, CA USA
Comparison of Average Transport and Dispersion Among a Gaussian Model, a Two-Dimensional Model and a Three-Dimensional Model
Mitchell, J. A.; Molenkamp, C. R.; Bixler, N. E.; Morrow, C. W.; Ramsdell, J. V.; May 13, 2004; 12 pp.; In English
Report No.(s): DE2005-15014231; UCRL-PROC-204132; No Copyright; Avail: Department of Energy Information Bridge

The Nuclear Regulatory Commission uses MACCS2 (MELCOR Accident Consequence Code System, Version 2) for regulatory purposes such as planning for emergencies and cost-benefit analyses. MACCS2 uses a straight-line Gaussian model for atmospheric transport and dispersion. This model has been criticized as being overly simplistic, although only expected values of metrics of interest are used in the regulatory arena. To test the assumption that averaging numerous weather results adequately compensates for the loss of structure in the meteorology that occurs away from the point of release, average MACCS2 results have been compared with average results from a state-of-the-art, 3-dimensional LODI (Lagrangian Operational Dispersion Integrator)/ADAPT (Atmospheric Data Assimilation and Parameterization Technique) and a Lagrangian trajectory, Gaussian puff transport and dispersion model from RASCAL (Radiological Assessment System for consequence Analysis). The weather sample included 610 weather trials representing conditions for a hypothetical release at the Central Facility of the Department of Energy's Atmospheric Radiation Measurement site.
NTIS
Advection; Three Dimensional Models; Two Dimensional Models

20050189271 Lawrence Livermore National Lab., Livermore, CA USA

Influences on the Height of the Stable Boundary Layer as Seen in LES

Kosovic, B.; Lundquist, J. K.; Jun. 23, 2004; 10 pp.; In English

Report No.(s): DE2005-15014318; UCRL-CONF-204845; No Copyright; Avail: Department of Energy Information Bridge

Climate models, numerical weather prediction (NWP) models, and atmospheric dispersion models often rely on parameterizations of planetary boundary layer height. In the case of a stable boundary layer, errors in boundary layer height estimation can result in gross errors in boundary-layer evolution and in prediction of turbulent mixing within the boundary layer. Ideally, observations would be used to determine the dependence of boundary layer height on parameters governing the flow in a boundary layer. However, observations of stably-stratified atmospheric boundary layers (ABLs) under idealized conditions which provide sufficient information about ABLs evolution under a wide range of conditions are either unattainable or rare. We therefore use controlled numerical experiments by performing numerical simulations of homogeneous, quasi-steady, stably-stratified ABLs which commonly occur in wintertime over sea-ice in polar regions.

NTIS

Boundary Layers; Computerized Simulation; Fluid Mechanics; Large Eddy Simulation; Vortices

20050192044 National Oceanic and Atmospheric Administration, Silver Spring, MD, USA

Report on Department of Energy Support for Operations of WMO/GAW Quality Control/Science Activity Center for the Americas

Hicks, B. B.; January 2003; 22 pp.; In English

Report No.(s): DE2005-821794; No Copyright; Avail: Department of Energy Information Bridge

As a formal activity of the World Meteorological Organization's Global Atmosphere Watch, to provide, through agency collaboration, a center of excellence in the USA that would impose quality assurance techniques on data collected by national air and precipitation quality networks operating in the Americas (north, south, and central).

NTIS

Meteorological Services; Quality Control

20050192306 Meteorological Satellite Center, Kiyose, Japan

Monthly Report of the Meteorological Satellite Center: April 2005

April 2005; In English; In Japanese; Document files and Satellite data are recorded in either ASCII or shift JIS code; Full Disk Earth's Cloud Images are recorded in Bit-Map (BMP) format; Copyright; Avail: Other Sources

The CD-ROM concerning the April 2005 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth's Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.

Derived from text

Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan

20050192307 National Oceanic and Atmospheric Administration, Ann Arbor, MI, USA

Conditional Probability of December and January Ice Cover at Selected Great Lakes Shore Sites

Jun. 2005; 36 pp.; In English

Report No.(s): PB2005-107439; NOAA/TM/GLERL-134; No Copyright; Avail: CASI; A03, Hardcopy

The National Weather Service (NWS) in Cleveland, Ohio requested improved information on ice cover for use in making outlooks of early winter ice cover at eight locations in the shore region of the Great Lakes (personal communication, Will Kubina). Bilello (1964) developed an empirical water temperature decline model to simulate the date of initial ice formation on bays and harbors. Greene (1983) applied the Billelo model to several sites along the St. Marys River. Assel and Norton (unpublished) applied the model to several additional Great Lakes shore sites, modified it for operational use, and provided it to the NWS in the mid-to-late 1980s. In this paper, empirical freezing degree-day (FDD) conditional probability and linear regression models of spatial average ice cover are described and discussed. These models are applied to the eight sites of

interest to the NWS to estimate early winter (December and January) spatial average ice cover.
NTIS
Great Lakes (North America); Ice; Probability Theory

20050192377 NASA Glenn Research Center, Cleveland, OH, USA
Mt. Washington Icing Sensors Project (MWISP) Tests Technologies for Remote Sensing of Icing Conditions
Reehorst, Andrew L.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Mt. Washington Icing Sensors Project (MWISP) was an intensive multiagency field test of remote-sensing technologies and methods for in-flight icing detection. This field test was the first comprehensive examination of multiple remote-sensing technologies, and it included ground and airborne in situ measurements for comparison. The data gathered will allow the assessment of icing remote-sensing technologies leading toward the development of ground-based and airborne systems. These systems will provide flight crews with the information required for avoiding or exiting hazardous icing conditions.
Author
Mountains; Ice Formation; Aviation Meteorology; Flight Conditions; Remote Sensors; Field Tests; Meteorological Instruments

20050192441 Carnegie Institution of Washington, Stanford, CA, USA
Eo-1 Hyperion Measures Canopy Drought Stress In Amazonia
Asner, Gregory P.; Nepstad, Daniel; Cardinot, Gina; Moutinho, Paulo; Harris, Thomas; Ray, David; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NAG5-8709; NCC5-481; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The central, south and southeast portions of the Amazon Basin experience a period of decreased cloud cover and precipitation from June through November. There are likely important effects of seasonal and interannual rainfall variation on forest leaf area index, canopy water stress, productivity and regional carbon cycling in the Amazon. While both ground and spaceborne studies of precipitation continue to improve, there has been almost no progress made in observing forest canopy responses to rainfall variability in the humid tropics. This shortfall stems from the large stature of the vegetation and great spatial extent of tropical forests, both of which strongly impede field studies of forest responses to water availability. Those few studies employing satellite measures of canopy responses to seasonal and interannual drought (e.g., Bohlman et al. 1998, Asner et al. 2000) have been limited by the spectral resolution and sampling available from Landsat and AVHRR sensors. We report on a study combining the first landscape-level, managed drought experiment in Amazon tropical forest with the first spaceborne imaging spectrometer observations of this experimental area. Using extensive field data on rainfall inputs, soil water content, and both leaf and canopy responses, we test the hypothesis that spectroscopic signatures unique to hyperspectral observations can be used to quantify relative differences in canopy stress resulting from water availability.
Derived from text
Drought; Structural Basins; Annual Variations; Amazon Region (South America); Cloud Cover; Moisture Content

20050192443 Spectral Sciences, Inc., USA
Atmospheric Correction Of Spectral Imagery: Evaluation Of The FLAASH Algorithm With Aviris Data
Matthew, Michael W.; Adler-Golden, Steven M.; Berk, Alexander; Felde, Gerald; Anderson, Gail P.; Gorodetsky, David; Paswaters, Scott; Shippert, Margaret; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 8 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): F19628-00-3010; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Visible to near infrared (NIR) hyperspectral imaging from aircraft or spacecraft is a highly valuable technology for remote sensing of the earth s surface because of its combination of good spatial and spectral resolution. Elimination of atmospheric effects caused by molecular and particulate scattering and absorption from the measurements is desired for many applications, such as when comparisons are to be made with data taken in the laboratory or under different atmospheric or viewing conditions. This process, which transforms the data from spectral radiance to spectral reflectance, is known as atmospheric correction, compensation, or removal. A variety of methods and algorithms for atmospheric correction are available. The empirical line method, consisting of a linear transformation derived from ground-truth spectra, remains a popular and accurate

method where truth data exist. In other situations, a first-principles method is needed. ATREM, developed by Gao et al. (1996) using the 5S and, later, 6S radiation transport (RT) models (Vermote et al., 1994), was for many years the industry-standard algorithm. Recently, more sophisticated algorithms have been developed, focusing primarily on land imagery. These algorithms, which incorporate more accurate RT models and improved methods for retrieving the atmospheric properties needed for the correction, include ATCOR (Richter, 1997), ACORN (Green, 2001), FLAASH (Matthew et al., 2000; Adler-Golden et al., 1998, 1999) and HATCH (Qu et al., 2001). In this paper we review the basic first-principles atmospheric correction methodology and present results from the latest version of FLAASH (Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes). FLAASH is an efficient correction code based on MODTRAN4 (Berk et al., 1998) that has been developed collaboratively by Spectral Sciences, Inc. and the Air Force Research Laboratory; with assistance from the Spectral Information Technical Applications Center (SITAC); FLAASH is available in the Research Systems Inc. ENVI software package. We show some comparisons of ground truth spectra with FLAASH-processed AVIRIS data, including results obtained using different processing options, and with results from ACORN that derive from an older MODTRAN4 spectral database.
Derived from text
Atmospheric Correction; Spectral Reflectance; Infrared Imagery; Near Infrared Radiation; Remote Sensing; Earth Surface; Spatial Resolution; Spectral Resolution; Algorithms

20050192450 Commissariat a l'Energie Atomique, Bruyeres-le-Chatel, France
Measuring Trace Gases In Plumes From Hyperspectral Remotely Sensed Data
Marion, Rodolphe; Michel, Remi; Faye, Christian; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 9 pp.; In English; See also 20050192435; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Characterizing surface and atmospheric properties from hyperspectral imaging spectrometry is of major importance in earth sciences. It has been successfully applied to geological, aquatic, ecological and atmospheric research (Curran, 1994) (Goetz, 1992). Hyperspectral sensors (e.g., AVIRIS, HyMap, Hyperion) are passive earth-looking systems providing radiance images in the solar reflected portion of the electromagnetic radiation spectrum. Generally, they cover a spectral range included in the 400-2500 nm window with a few hundred contiguous bands about 10 nm wide. The nominal pixel size is about 20 m. Typical signal to noise ratios (SNR) are a few hundred. As an example, the AVIRIS spectral range is 400-2500 nm, the number of bands is 224, the spectral bands are about 10 nm wide, the spatial resolution is about 20 m, and the SNR is between 300 and 800 for the year 1995. The images depend on sun irradiance, atmospheric conditions, ground conditions, and on the system s transfer function in a complex way (scattering, absorption, reflection, averaging), leading to a strongly non-linear pixel equation (3). Fig. 1 shows a diagram of the hyperspectral observational geometry.
Derived from text
Trace Elements; Plumes; Remote Sensing; Atmospheric Composition; Surface Properties; Meteorological Parameters

20050192459 Rochester Inst. of Tech., NY, USA
A Subpixel Target Detection Technique Based On The Invariance Approach
Schott, John R.; Lee, Kyungsuk; Raqueno, Rolando; Hoffmann, Gary; Healey, Glenn; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 9 pp.; In English; See also 20050192435; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper introduces a method for detection of subpixel targets in image spectrometer data cubes. It is based on the premise that we know what the target is and can characterize it in terms of its reflectance spectrum r(lambda). Furthermore, we assume the target may exist at spatial scales such that it will present itself as a fraction of a pixel and that it may exist in a significant number of pixels (more specifically we can t assume that we can insure that a significant region of the scene does not contain any targets). We desire a data processing approach that can mitigate atmospheric and illumination effects such that atmospheric correction is not a required prerequisite for the method. The approach presented here involves defining a target spectral subspace that is common across the wide range of atmospheric illumination and viewing conditions that might exist in the scene (i.e., the target subspace is invariant to environmental changes within the scene). The target may be manifest at different locations within the subspace but is not expected to appear outside the subspace. We then introduce a method to characterize a background subspace using the same convex hull geometry used to define the target subspace (i.e., the target subspace and background subspace are defined in a common spectral space but ideally there is little or no overlap between the two subspaces). We then introduce a subpixel target detection algorithm that is based on how well each pixel spectrum can be described by either a set of background basis vectors or a combination of target and background basis vectors. The

result is a subpixel target detection algorithm that only requires the target spectrum and a radiance image cube (i.e., an image spectrometer data set calibrated into sensor reaching radiance). The performance of the resulting algorithm is shown for both a HYDICE image and an AVIRIS image. These initial results demonstrate the potential of the approach showing very good background suppression (low false alarms) and a high degree of target detection.
Derived from text
Invariance; Atmospheric Correction; Infrared Spectrometers; Data Processing; Target Acquisition; Pixels; Atmospheric Effects; Algorithms

48
OCEANOGRAPHY

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

20050192437 Office of Naval Research, Washington, DC, USA
Analysis Of AVIRIS Data From LEO-15 Using Tafkaa Atmospheric Correction
Montes, Marcos J.; Gao, Bo-Cai; Davis, Curtiss O.; Moline, Mark; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 6 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NAG5-8674; Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We previously developed an algorithm named Tafkaa for atmospheric correction of remote sensing ocean color data from aircraft and satellite platforms. The algorithm allows quick atmospheric correction of hyperspectral data using lookup tables generated with a modified version of Ahmad & Fraser s vector radiative transfer code. During the past few years we have extended the capabilities of the code. Current modifications include the ability to account for within scene variation in solar geometry (important for very long scenes) and view geometries (important for wide fields of view). Additionally, versions of Tafkaa have been made for a variety of multi-spectral sensors, including SeaWiFS and MODIS. In this proceeding we present some initial results of atmospheric correction of AVIRIS data from the 2001 July Hyperspectral Coastal Ocean Dynamics Experiment (HyCODE) at LEO-15.
Derived from text
Atmospheric Correction; Airborne Equipment; Remote Sensing; Radiative Transfer; Imaging Spectrometers; Low Earth Orbits; Ocean Dynamics

20050192442 New Jersey Inst. of Tech., NJ, USA
Retrieval of Marine Water Constituents Using Atmospherically Corrected AVIRIS Hyperspectral Data
Bagheri, Sima; Peters, Steef; Proceedings of the 12th JPL Airborne Earth Science Workshop; [2004]; 5 pp.; In English; See also 20050192435; Original contains color illustrations
Contract(s)/Grant(s): NSF BES-98-06982; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper reports on the validation of bio-optical models in estuarine and nearshore (case 2) waters of New Jersey-New York to retrieve accurate water-leaving radiance spectra and chlorophyll concentration from the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) imaging spectrometer data. MODTRAN-4 was applied to remove the effects of the atmosphere so as to infer the water-leaving radiance. The study area - Hudson/Raritan of New York and New Jersey (Figure 1) is an extremely complex estuarine system where tidal and wind-driven currents are modified by freshwater discharges from the Hudson, Raritan, Hackensack, and Passaic rivers. Over the last century, the estuarine water quality has degraded in part due to eutrophication, which has disrupted the preexisting natural balance, resulting in phytoplankton blooms of both increased frequency and intensity, increasing oxygen demand, and leading to episodes of hypoxia. As the end result, a thematic map of chlorophyll-a concentration was generated using an atmospherically corrected AVIRIS ratio image. This thematic map serves as an indication of phytoplankton concentration. Such maps are important input into the geographic information system (GIS) for use as a management tool for monitoring water resources.
Derived from text
Air Water Interactions; Water Quality; Nearshore Water; Chlorophylls; Phytoplankton; Eutrophication; Atmospheric Effects; Infrared Imagery

51
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

20050189161 Wyle Labs Life Science and Services, Inc., San Antonio, TX USA

Altitude Decompression Sickness Susceptibility: Influence of Anthropometric and Physiologic Variables

, James T; Pilmanis, Andrew A.; Balldin, Ulf I.; Fischer, Joseph R.; Feb. 2005; 6 pp.; In English

Contract(s)/Grant(s): FA8650-04-D-6472; Proj-7184

Report No.(s): AD-A434531; AFRL-HE-BR-JA-2005-0025; No Copyright; Avail: CASI; A02, Hardcopy

There is considerable variability in individual susceptibility to altitude decompression sickness (DCS). The air Force Research Laboratory Altitude DCS research Database consists of extensive information on 2980 altitude exposures conducted with consistent procedures and endpoint criteria. We used this database to quantify the variation in susceptibility and determine if anthropometric and/or physiologic variables could be used to predict DCS risk. There were 240 subjects who participated in at least 4 of 70 exposure profiles in which between 5 and 95% of all subjects tested developed DCS symptoms. A subject/Study Ratio (SSR) was calculated by dividing the DCS experienced by a subject during all their exposures by the DCS incidence for all subjects who participated in the identical exposures. The SSR was used to identify the relative susceptibility of subjects for use in analyzing possible relationships between DCS susceptibility and the variables of height, weight, body mass index, age, percent body fat, and aerobic capacity. The DCS incidence was 46.5% during 1879 subject-exposures by subjects exposed at least 4 times. A significant relationship existed between higher DCS susceptibility and only the combination of lower aerobic capacity and greater weight (P\h0.05). Despite a correlation, less than 13% of the variation in DCS susceptibility was accounted for by the best combination of variables; weight and VO2max. Differences in DCS susceptibility cover a wide range and appear to be related to some anthropometric and physiologic variables. However, there was insufficient correlation to allow prediction of an individual's susceptibility.

DTIC

Altitude Sickness; Anthropometry; Decompression Sickness; Physiology

20050189162 Naval Health Research Center, San Diego, CA USA

The Air Force Critical Care Air Transport Team (CCATT): Using the Estimating Supplies Program (ESP) to Validate Clinical Requirements

Nix, Ralph E.; Hill, Martin; Onofrio, Kathleen; Konoske, Paula J.; Galarneau, Mike R.; Apr. 2005; 57 pp.; In English

Report No.(s): AD-A434505; NHRC-05-04; No Copyright; Avail: Defense Technical Information Center (DTIC)

The Air Force Medical Support Agency, Surgeon General Support Logistics Office requested that the Naval Health Research Center (NHRC) conduct a proof of concept study to assess the validity and feasibility of using a medical modeling tool developed by NHRC in U.S. Air Force Allowance Standard (AS) development and management. The Air Force Critical Care Air Transport Team (CCATT) Unit Type Code AS was selected for this study with the goal of developing an inventory validation process using the databases in the NHRC Modeling and Simulation laboratory. The primary objective of this study was to provide the Air Force with the ability to validate the clinical requirements of the CCATT assemblage by using the NHRC Estimating Supplies Program to establish a viable audit trail linking clinical requirements with supply items.

DTIC

Air Transportation; Data Bases; Estimating; Models; Supplying

20050189187 Naval Health Research Center, San Diego, CA USA

Meloquine Use and Hospitalizations Among US Service Members, 2002-2004

Wells, Timothy S.; Smith, Tyler C.; Smith, Besa; Wang, Linda Z.; Hansen, Christian J.; Reed, Robert J.; Goldfinger, Wendy; Corbeil, Thomas E.; Spooner, Christiana N.; Ryan, Margaret K.; Apr. 2005; 21 pp.; In English

Report No.(s): AD-A434503; NHRC-05-05; No Copyright; Avail: Defense Technical Information Center (DTIC)

The safety of mefloquine, a common antimalarial drug sold under the trade name Lariam, has not been well described in military populations. To use readily available electronic data to determine mefloquine prescriptions and disease outcomes, as measured by hospitalization, to study mefloquine safety among US service members from 2002 through 2004. Using an electronic pharmaceutical database, 8858 mefloquine-prescribed and deployed personnel were identified and compared with 2 reference groups. The reference groups comprised US service members who were not prescribed mefloquine and resided in Europe or Japan (n = 156 203) or had been otherwise deployed (n = 232 381) during the study period. Hospitalizations and

diagnoses were assessed from standard military databases, and differences in these outcomes were evaluated using Cox proportional hazards modeling. Broad illness and injury categories, as well as specific mental health groupings identified through Department of Defense hospitalization data. In comparison with active-duty US service members residing in Europe or Japan, US service members were at a statistically significant decreased hazard for any-cause hospitalization, as well as to diseases of the respiratory and digestive systems, musculoskeletal system and connective tissue diseases, injuries and poisonings, ill-defined conditions, and mood disorders. These results suggest there is no association between mefloquine prescriptions and severe health effects, as measured by hospitalizations, across a wide range of outcomes.
DTIC
Military Personnel; Drugs

20050189190 Naval Health Research Center, San Diego, CA USA
The Many Faces of Meningococcal Disease: A Case Series and Review of Presentations and Treatment Options
Crum, Nancy F.; Chapman, Frank A.; Russell, Kevin L.; Hale, Braden R.; Jan. 2004; 21 pp.; In English
Report No.(s): AD-A434380; NHRC-04-15; No Copyright; Avail: CASI; A03, Hardcopy

We present three cases of Neisseria meningitidis with varied clinical presentations, including meningococcemia, meningitis, and pneumonia. Our cases suggest an association between concomitant bacterial and viral infections, including group A streptococcus and adenovirus, and an increased risk of invasive Neisseria infections. Polymerase chain reaction data are a useful adjunct to bacterial cultures for the diagnosis. Our case series exemplify the continued high mortality of N. meningitides and highlights the need for more immunogenic vaccines for prevention.
DTIC
Meningitis; Health; Infectious Diseases

52
AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments, see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

20050192285 Institute of Space Medico-Engineering, Beijing, China
Space Medicine and Medical Engineering, Volume 18, No. 2
Wei, Jin-He, Editor; Chen, Shan-Guang, Editor; Su, Shuang-Ning, Editor; Jiang, Shi-Zhong, Editor; Wang, Xian-Min, Editor; Liu, Xin-Min, Editor; Su, Hong-Yu, Editor; Bai, Jing, Editor; Sun, Xi-Qing, Editor; Liu, Yong, Editor; April 2005; ISSN 1002-0837; 83 pp.; In English; In Chinese; See also 20050192286 - 20050192303
Report No.(s): CN-11-2774/R; Copyright; Avail: Other Sources

The Journal of Space Medicine and Medical Engineering is presented. The topics include: 1) Changes of Hippocampus Somatostatin and Learning Ability in Rats after + Gz Exposure; 2) Dynamic Responses of Human Body and Human Surrogate to Different Impacts under 30 degree Supine position; 3) Effects of Nifedipine on Myosin Heavy Chain (MHC) Isoforms Transition in Unloaded Soleus; 4) Changes of Endogenous Ouabain in Rat Serum and Certain Tissues after Exposure to Simulated Weightlessness; 5) Behavioral Changes of Rats under Rotation Stimulation; 6) Experimental Study on Mechanism of Recompression Therapy of Decompression Sickness; 7) Changes of EEG Frequency-fluctuation Characteristics during Visual Workloads; 8) Extraction of Rabbit Somatosensory Evoked Potentials (SEP) with Independent Component Analysis; 9) Biological Effects of Space Flight on Several Opportunistic Pathogenic Bacteria and Biodestructive Fungi; 10) A Study on Space Mutation of Streplomyces Fradiae; 11) Detection of Small Molecules Based on Surface Plasman Resonance Technology; 12) A Study Simulation of Electrical Impedance Scan-imaging Based on a Phantom; 13) A Medical Ultrasonic Image Filtering Method Based on Anisotropic Diffusion; 14) Design of Mechanical Structure Dynamic Characteristics and Development of Verification System; 15) Malfunction Simulation by Spaceflight Training Simulator; 16) Changes of Somatostatin (SS) in Stomach and Duodenum of Rats after + Gz Exposure; 17) The Effect of Ribozyme Specially Cleaving per1 mRNA on c-fos mRNA and Its Expression in Hippocampus of Morphine Addicted Mice; and 18) ERP Correlates of Recognition Memory for Chinese Words.
CASI
Aerospace Medicine; Bioengineering

20050192286 Fourth Military Medical Univ., Xi'an, China

Effects of Nifedipine on Myosin Heavy Chain (MHC) Isoforms Transition in Unloaded Soleus

Feng, Han-Zhong; Yu, Zhi-Bin; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 89-93; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to observe the effects of nifedipine, a blocker of L-type Ca(2+) channel, on soleus weight and expression of myosin heavy chain (MHC) isoforms in control and tail-suspended rats. Animals were treated with nifedipine at a dose of 10 mg/kg per day in drinking water for 1 or 2 weeks. The expression of MHC isoform protein was observed by SDS-polyacrylamide gel electrophoresis at 4 T. The expression of MHC mRNA was detected by RT-PCR. The relative weight(muscle weight/body weight) of soleus muscle was decreased by 39.5% and 51.7% in 1 and 2 weeks of tail-suspended group respectively, but no changes in extensor digitorum longus (EDL) weight was found. The relative weight of soleus and EDL in 1 or 2 weeks of nifedipine treated control group showed no changes as compared with the untreated control group. The relative weight of soleus in 1 or 2 weeks of nifedipine treated tail-suspension group decreased by 36.6% or 52.0%, respectively, as compared with control, but there was no difference between tail-suspension group with or without nifedipine treatment. The expression of MHC I , IIa mRNA and protein could be detected in control soleus with or without nifedipine treatment. The expression MHC I, IIa, IIx and IIb mRNA was detected in 1 or 2 weeks of unloaded soleus with or without nifedipine treatment. Nifedipine inhibited the expression of II type MHC mRNA in unloaded soleus and expression of MHC IIa protein in control and unloaded soleus. Nifedipine can not resist atrophy of unloaded soleus, but inhibit the transition of MHC from slow to fast isoforms at the transcription level.

Author (revised)

Hindlimb Suspension; Rats; Myosins; Body Weight

20050192287 Institute of Space Medico-Engineering, Beijing, China

Biological Effects of Space Flight on Several Opportunistic Pathogenic Bacteria and Biodestructive Fungi

Xie, Qiong; Li, Yong-Zhi; Shi, Hong-Zhi; Wu, Yuan-Liang; Su, Shuang-Ning; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 117-120; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to investigate biological effects of space flight on several conditional pathogenic bacteria and biodestructive fungi. Several potentially pathogenic or biodegrading microorganisms, including bacteria, actinomyces and fungi , were carried on-board spacecraft for 7 d. Some of the biological characteristics were studied by using general microbial test technology after recovery. In space condition, survival and growth rate were promoted, and soluble pigments were produced, while morphological properties were changed differently. The antibiotic-sensitivity of certain strains decreased, while most of them showed no changes. The reproduction ability and growth rate of these microorganisms are promoted after being carried into space, and morphological differentiation increase. The resistance to antibiotics is stable.

Author (revised)

Bacteria; Biological Effects; Fungi; Pathogens; Space Flight; Biodegradation

20050192288 Institute of Space Medico-Engineering, Beijing, China

Detection of Small Molecules Based on Surface Plasmon Resonance Technology

Wang, Chun-Yan; Xiong, Jiang-Hui; Zhong, Ping; Yang, Tang-Bin; Li, Na; Li, Ying-Hui; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 126-129; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to develop a detective method applied in online assaying of astronauts' humours using the portable online bio-molecules analyzer (POBA) based on surface plasmon resonance biosensor. An assay format was developed based on the detection of 2,4-Dinitrophenyl-hydrazine. The bio-molecule slide was made by DNP-BSA. Range of detection and standard curve were obtained using inhibition assay. Reliability and specificity of the assay were also tested. 1) The linear range of the assay was 7.8 nanograms per milliliter approximately 2 micrograms per milliliter with lower detection limit of 2.5 nanograms per milliliter; 2) Preparation of the bio-molecule slide and regeneration of the biosensor ensured detections for many samples. This assay method can be used to detect small molecules sensitively, rapidly and easily. It can be repeated with good reliability,and has a good application in space medicine.

Author (revised)

Aerospace Medicine; Surface Plasmon Resonance; Detection; Molecules; Bioinstrumentation

20050192289 Fourth Military Medical Univ., Xi'an, China

A Simulation Study of Electrical Impedance Scan-imaging Based on a Phantom

Ji, Zhen-Yu; Fu, Feng; Shi, Xue-Tao; Liu, Rui-Gang; Dong, Xiu-Zhen; You, Fu-Sheng; Wang, Kan; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 130-134; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to testify the feasibility of electrical impedance scanning (EIS) imaging and to classify the factors influencing EIS imaging at the early stage of electrical impedance scanning breast imaging study. Based on the EIS experiment workplace, a phantom to simulate the distribution of breast tissue was designed. Using NaCl solution and agar block with different conductance, three kinds of electric fields disturbances were simulated. Different electric fields disturbance induced by different conductance distributions bring different imaging effects. The imaging based on the theory of EIS is feasible. Initiative factors influencing EIS imaging are confirmed.
Author
Breast; Electrical Impedance; Imaging Techniques; Simulation; Scanning

20050192290 Sichuan Univ., Chengdu, China
A Medical Ultrasonic Image Filtering Method Based on Anisotropic Diffusion
Peng, Yun; Li, De-Yu; Lin, Jiang-Li; Wang, Tian-Fu; Zheng, Chang-Qiong; Tang, Hong; Rao, Li; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 135-139; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to remove the speckle noise in ultrasonic images by using anisotropic diffusion method. Based on anisotropic diffusion, a partial differential equation, of which the initial data was the input images, was transformed into differential forms and solved with iterations. The speckle scale function of the equation was modified to make better use in filtering medical ultrasonic images. By comparing the results with other three filters, the anisotropic diffusion method could smooth the speckles very well and the edge of the image was also clear. Anisotropic diffusion can remove the speckle noise effectively and has great potential in filtering medical ultrasonic images.
Author (revised)
Anisotropy; Diffusion; Ultrasonics; Aerospace Medicine; Image Filters

20050192292 Institute of Space Medico-Engineering, Beijing, China
Malfunction Simulation by Spaceflight Training Simulator
Chang, Tian-Chun; Zhang, Lian-Hua; Xue, Liang; Lian, Shun-Guo; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 144-147; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to implement malfunction simulation in spaceflight training simulator. The principle of malfunction simulation was defined according to spacecraft malfunction predict and its countermeasures. The malfunction patterns were classified, and malfunction type was confirmed. A malfunction simulation model was established, and the malfunction simulation was realized by math simulation. According to the requirements of astronaut training, a spacecraft subsystem malfunction simulation model was established and realized, such as environment control and life support, GNC, push, power supply, heat control, data management, measure control and communication, structure and so on. The malfunction simulation function implemented in the spaceflight training simulator satisfied the requirements for astronaut training.
Author (revised)
Malfunctions; Simulation; Space Flight; Training Simulators

20050192293 Institute of Space Medico-Engineering, Beijing, China
Dynamic Responses of Human Body and Human Surrogate to Different Impacts under 30 deg. Supine Position
Tan, Cheng; Guo, Yao-Yu; Yang, Hong-Hui; Jiang, Shi-Zhong; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 84-88; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to study the difference between the dynamic responses of human body and human surrogate under 30 degrees supine position, and to discuss impact probability of substituting human body with human surrogate in impact tests. Five volunteers experienced half-sine impact pulses, averaged 4.76, 8.96, 11.33 G, lasting for 40 - 60 ms on an impact tower. The human surrogate was exposed to half-sine impact pulses, averaged 6.77,10.39, 16.93,21.11, 24.98, 31.11 G, lasting for 40-60 ms, two times for each G level. ECG changes of the volunteers were continuously monitored before, during and after each impact. Result Output responses at forehead and chest of human body and human surrogate increased with input increments. But there was obvious difference of the dynamic responses between human body and the surrogate to impact of low G levels. Heart rate of each volunteer had temporary increase during the process of impact, and returned to normal level soon after the impact. There is difference in a certain extend between the dynamic responses of human body and human surrogate. The ECG changes are induced mainly by mental stress during process of impact.
Author (revised)
Dynamic Response; Human Body; Supine Position; Electrocardiography

20050192294 Institute of Space Medico-Engineering, Beijing, China

Changes of EEG Frequency-fluctuation Characteristics during Visual Workloads

Han, Dong-Xu; Zhou, Chuan-Dai; Liu, Yue-Hong; Pang, Li-Wei; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 107-111; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to observe the changes of a-band frequency-fluctuation characteristics of EEG under visual task. Nineteen healthy right-handed male volunteers served as subjects, aged 24 -32. EEG were recorded during rest (eyes-closed and eyes-open) and visual task, then analyzed using EEG frequency-fluctuation analysis system. From eyes-closed to eyes-open, then to visual task state, the probability distribution characteristics of a-band frequency-fluctuation were significantly changed. The probability of 9 Hz and 10 Hz dominance decreased significantly, while the probability of 8 Hz and 11 - 13 Hz dominance increased significantly. The single component occupying absolute dominance was gradually transformed into the competition between these various components, and the lower frequency component in the front brain-areas gradually occupied dominance; meanwhile, the dominant fluctuation entropy increased significantly, the dominant fluctuation energy decreased significantly, and these processes showed obviously the brain-area related characteristics. These changes of alpha-band frequency-fluctuation characteristics reflect the further enhancement of brain activities in the areas related to visual task. This method may be helpful in the study of visuai workloads.

Author (revised)

Electroencephalography; Frequency Distribution; Visual Tasks; Workloads (Psychophysiology); Variations

20050192295 Chongqing Univ. of Posts and Telecommunications, Chongqing, China

Extraction of Rabbit Somatosensory Evoked Potentials (SEP) with Independent Component Analysis

Li, Zhang-Yong; Liu, Sheng-Rong; Xie, Zheng-Xiang; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 112-116; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to extract rabbit somatosensory evoked potentials (SEP), by using a new technique named independent component analysis. The rabbit was narcotized and stimulated with 0.5 Hz electric pulse. Potentials at scalp was sampled at 3 764 Hz. Response signals to repeated stimulations for 3 times mixed with background noise was acquired at the same collection point. Independent component analysis (ICA) for SEP was established. The mixed signals were decomposed by ICA to observe the independent components. Independent SEP was acquired. A time lag of continuous signal source is suitable to SEP model. ICA can extract signals of SEP components.

Author (revised)

Evoked Response (Psychophysiology); Extraction; Rabbits; Sensory Perception; Bioelectric Potential

20050192296 People's Liberation Army Hospital, Jinan Shandong, China

Changes of Somatostatin (SS) in Stomach and Duodenum of Rats after + Gz Exposure

Zhong, Xue-Jun; Wu, Zhan-Jun; Sun, Yan-Ping; Xu, Gang; Xu, Kui-Gao; Tian, Guang-Qing; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 148-150; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to study effects of +Gz exposure on the change of somatostatin (SS) in stomach and duodenum of rats. Forty male Wista rats were randomly divided into +1 Gz control group, +5 Gz x5 min group, +10 Gz x5 min group and repeated exposure[(+5 Gz x2 min) + (+ 10 Gz x2 min) + (+5 Gz x2 min)]group. After + Gz exposure, the rats in each group were anesthetized by ether, and gastric and duodenal mucosa were taken immediately. Levels of SS were assayed using radioimmunoassay (RIA) methods. Gastric and duodenal mucosa of the control group and +5 Gz group were intact and smooth. Under naked eye and light microscope, scattered hemorhagic spoto, small ulcers, submucosal hyperemia, and erosion of mucosa were found in gastric antrum and duodenum in +10 Gz group rats. Diffuse hyperemia, erosion and small ulcers were found in mucosa of gastric fundus, gastric antrum and duodenum of repeated exposure group. Exposure to +Gz can increase somatostatin content in gastric antrum and duodenum(P less than 0. 01). Increase of SS content may play an important role in the prevention of pathogenesis of stomach and duodenum after +G exposure.

Author (revised)

Exposure; Radioimmunoassay; Rats; Stomach

20050192297 Fourth Military Medical Univ., Xi'an, China

Changes of Hippocampus Somatostatin and Learning Ability in Rats after + Gz Exposure

Cao, Xin-Sheng; Sun, Xi-Qing; Wu, Yan-Hong; Wu, Xing-Yu; Liu, Ting-Song; Zhang, Shu; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 79-83; In English; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to investigate changes of learning ability and somatostatin (SS) changes after positive

acceleration (+Gz) exposures. Eighty male SD rats were randomly divided into 3 groups: control group(Con), +6 Gz/3 min group (+6 Gz), and +10 Gz/3 min group (+10 Gz), 8 rats in each group. Changes of learning ability in rats were observed at 0 d, 2 d, 4 d and 6 d after + Gz exposure. SS in hippocampus was measured by RIA at 0 d, 2 d and 4 d after + Gz exposures (there were 8 rats every time, in each group). Result In Y-maze test,number of correct response decreased significantly (P less than 0.01) ,and total reaction time increased significantly (P less than 0.01) in +6 Gz and +10 Gz groups as compared with control group; number of correct response and total reaction time in +10 Gz group changed significantly at 0 d(P less than 0.01 or P less than0.05) as compared with +6 Gz group. RIA showed that, content of SS in hippocampus declined at 0 d and 2 d(P less than 0.05 or P less than 0.01) in +6 Gz and + 10 Gz groups as compared with control group. + Gz exposure could impair learning ability of rats, and inhibit expression of SS in hippocampus.
Author (revised)
Hippocampus; Rats; Learning; High Gravity Environments

20050192298 Sichuan Univ., Chengdu, China
The Effect of Ribozyme Specially Cleaving perl mRNA on c-fos mRNA and Its Expression in Hippocampus of Morphine Addicted Mice
Liu, Ying-Hui; Peng, Tao; Chen, Li-Guo; Xiao, Jing; Wang, Zheng-Rong; Liu, Yan-You; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 151-153; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to study the change of c-fos mRNA and protein in hippocampus of morphine addicted mice after injected with ribozyme specially cleaving perl mRNA. The recombined plasmid pcDNA 3.l-per1 RZ DNA was injected into the ventricles of morphine addited mice to transcript the corresponding ribozyme which cleaves per1 mRNA particularly. And then, the brains of mice were fixed by perfusion. The level of c-fos mRNA was assayed by in situ hybridization and c-fos protein was detected by immunohistochemical staining. The level of c-fos mRNA and protein decreased after injection of the recombined plasmid pcDNA 3.l-per1 RZ DNA expressing the ribozyme cleaving perl mRNA. The ribozyme specially cleaving perl mRNA has potential function in inhibiting the transcription and expression of c-fos and blocking the morphine addition.
Author (revised)
Hippocampus; Mice; Morphine; Proteins; Ribonucleic Acids

20050192299 Second Military Medical Univ., Shanghai, China
Behavioral Changes of Rats under Rotation Stimulation
Cai, Yi-Ling; Ma, Wen-Ling; Li, Min; Ouyang, Ru-Ying; Hu, Liang; Sun, Ya-Lin; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 98-101; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to assess the specification and efficiency of rotation sickness indices by monitoring changes of behaviors in rats under rotation stimulation. Method SD rats were stimulated by Crampton model with different time courses. Pica or kaolin consumption (KC), conditioned taste aversion (CTA) or saccharine water ingestion (SWI) , 2 h food ingestion (2hFI), and open-field test (OFT) scores were observed. Apparent changes of the four indices were observed after rotation stimulation. SWI, OFT scores and 2hFI decreased exponentially with increase of duration of the motion stimulation. KC increased linearly with the increase of time within 12 h stimulation. After 18 h stimulation, KC decreased to a level even lower than that after 6 or 12 h stimulation. The adjusted correlation between changes of the indices and duration of stimulation within 12 h are : 0.94 for KC, 0.54 for SWI, 0.44 for 2hFI and 0.34 for OFT. The maximum efficiency of the four indices appeared at 6-hour stimulation: 70% for KC, 90% for SWI, 80% for 2hFI and 95% for OFT. It is found that pica and CTA were more specific than the other indices. They may serve as primary indices and can be combined with the secondary indices such as 2hFI or OFT. Six hours is the optimal duration of stimulation by Crampton model for rotation sickness studies.
Author (revised)
Motion Sickness; Rotation; Stimulation; Rats; Behavior

20050192300 Naval Medical Research Inst., Shanghai, China
Experimental Study on Mechanism of Recompression Therapy of Decompression Sickness
Yuan, Jin-Fu; Ji, Zhong-Yi; Lei, Cheng-Xiang; Wang, Ping; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 102-106; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to elucidate that recompression is the most efficient measure in removing the pathogenic factors. When rabbits were suffering from severe DCS, their pressure were immediately compressed to 0.5 Mpa. Precordial

region was monitored continuously with a Doppler flow meter, micrography of the bulbar conjunctiva was done intermittently and the behaviors of the animals were recorded. Effects of therapeutic recompression and elimination of circulating bubbles were correlated to rate and extent of recovery of microvascular function. The animals DCS with severe dysfunction or failure of blood vessels, DCS became worse owing to progressive impairment of microvascular function during recompression and decompression. The pressure could only cancel the tension provoked by supersaturated gas in the blood so as to relieve the spasm of the compensatory blood vessels, which can restore the blood circulation and reverse the developing course of the DCS. The pressure, however, couldn't recover the function of the blood vessels with severe dysfunction or failure, or repair the injured tissues, or eliminate the circulating bubbles directly.
Author (revised)
Compressing; Decompression Sickness; Pathogens; Therapy

20050192301 Dawn Aerospace Technology Co. Ltd., Beijing, China
A Study on Space Mutation of Streptomyces Fradiae
Fang, Xiao-Mei; Zhao, Zhi-Jia; Gu, Hai-Ke; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 121-125; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to study the rule of mutation of streptomycesfradiae during spaceflight, and to select efficient tylosin producing strains for industrial production. Streptomyces fradiae 9940S+ -86 were carried on-board spaceship 'Shenzhou' I, 'Shenzhou' III and 'Shenzhou' IV sequentially to achieve spaceflight mutation breeding experiment. After space experiments and the screening tests in the lab, 48 strains were obtained which promoted production by +20% or more at shaker level. And the highest production of a strain was 14 950 micrograms per milliliter, which means an increase of 91.5%. Comparing the results of three tests, it is found that the outer space environment can lead to a cumulative mutation. After the medium scale tests and production experiments, strain T1-156-84-23 was finally selected to be used for sample production. And its output was increased by 18%.
Author (revised)
Mutations; Space Flight; Chinese Space Program; Breeding (Reproduction); Streptomycetes; Aerospace Medicine

20050192302 Central-South Univ. of Technology, Changsha, China
ERP Correlates of Recognition Memory for Chinese Words
Wang, Xiang; Cheng, Zao-Huo; Yao, Shu-Qiao; Zhao, Lun; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 154-156; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to study the ERP old/new effects during a recognition task for Chinese words. Twenty one healthy right-handed volunteers received a Chinese words recognition task. The stimuli were meaningful words consisting of two Chinese characters. The EEG signals were recorded from 9 scalp sites of the extended 10-20 systems. Compared with the new words, the old words elicited larger N320 (the frontal old/new effect) at the frontal brain areas and larger LPC (the parietal old/new effect) at the parietal brain areas. And the peak of LPC appeared significantly earlier in old words ERPs than in new words ERPs. The old/new effect is significant for the recognition of Chinese words, which also consists of the frontal old/new effect and the parietal old/new effect. The parietal old/new effect is positive-going, but the frontal old/new effect is negative-going. The frontal old/new effect might be affected by the language and material.
Author (revised)
Words (Language); Memory; Correlation; Electroencephalography

20050192303 Xian Jiaotong Univ., China
Changes of Endogenous Ouabain in Rat Serum and Certain Tissues after Exposure to Simulated Weightlessness
Liu, Zhao-Xia; Gao, Guang-Dao; Hu, Yong-Jie; Wang, De-Sheng; Wu, Da-Wei; Yuan, Ming; Li, Zhi-Li; Space Medicine and Medical Engineering, Volume 18, No. 2; April 2005, pp. 94-97; In Chinese; See also 20050192285; Copyright; Avail: Other Sources

The objective of this research is to investigate the changes of endogenous ouabain (EO) in rat serum and some tissues after exposure to simulated weightlessness and to investigate its possible pathophysiology. Male Wistar rats were randomly divided into control group(Con) and 1 week tail-suspension group(TS). Enzyme-linked immunosorbent assay(ELISA) was used to detect the content of EO in serum, hypothalamus, pituitary, adrenal gland, kidney, heart and liver. Compared with Con, EO increased significantly in serum, hypothalamus, adrenal gland and kidney after tail suspension (P less than 0.05).

Simulated weightlessness induced changes of EO in serum and some tissues, which may have some effects on the regulation of hydro-electrolyte metabolism and cardiovascular functions.
Author (revised)
Rats; Serums; Weightlessness Simulation; Tissues (Biology); Electrolytes; Cardiovascular System

53
BEHAVIORAL SCIENCES

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

20050186911 NASA Johnson Space Center, Houston, TX, USA
Cognition in Space Workshop, 1, Metrics and Models
Woolford, Barbara; Fielder, Edna; June 2005; 18 pp.; In English; Cognition in Space Workshop I: Metrics and Models, 25-27 Oct. 2004, Chandler, AZ, USA
Report No.(s): NASA/TM-2005-213161; S-956; No Copyright; Avail: CASI; A03, Hardcopy

'Cognition in Space Workshop I: Metrics and Models' was the first in a series of workshops sponsored by NASA to develop an integrated research and development plan supporting human cognition in space exploration. The workshop was held in Chandler, Arizona, October 25-27, 2004. The participants represented academia, government agencies, and medical centers. This workshop addressed the following goal of the NASA Human System Integration Program for Exploration: to develop a program to manage risks due to human performance and human error, specifically ones tied to cognition. Risks range from catastrophic error to degradation of efficiency and failure to accomplish mission goals. Cognition itself includes memory, decision making, initiation of motor responses, sensation, and perception. Four subgoals were also defined at the workshop as follows: (1) NASA needs to develop a human-centered design process that incorporates standards for human cognition, human performance, and assessment of human interfaces; (2) NASA needs to identify and assess factors that increase risks associated with cognition; (3) NASA needs to predict risks associated with cognition; and (4) NASA needs to mitigate risk, both prior to actual missions and in real time. This report develops the material relating to these four subgoals.
Author
Cognition; Space Exploration; Risk; Systems Integration; Human Performance; Real Time Operation

20050186946 Catholic Univ. of America, Washington, DC, USA
The Behavioral Sciences in the Space Age
Furfey, Paul Hanly; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 27-29; In English; See also 20050186936; Copyright; Avail: Other Sources

In the behavioral sciences it is often convenient to analyze human behavior as the reaction of man to his environment. These two things, then, man and his environment, contain all the factors that explain behavior. Human nature, as far as we can tell, is unchanging. There is no reason to think that it is different now from what it was in the earliest centuries for which we have any information. In contrast, however, man's environment has been changing constantly with the spread of geographical exploration and the development of technology. We act differently from our fathers because we live in a different world, and our fathers acted differently from our grandfathers for the same reason. Right now we are on the verge of a sensational break-through. Man's environment has always been limited to this terrestrial globe, but now it is to be extended to outer space. Human behavior has always been man's reaction to his terrestrial environment, but now it will begin to include his reaction to an extraterrestrial environment. Because the latter is so different from the former, because adjusting to life in outer space is so different from adjusting to life on this earth, human behavior is bound to show novel features. This is the essential reason why the space age is such a challenge to the behavioral sciences. Very soon indeed we expect men to make flights into space, short flights at first and then longer ones. After that there will be large permanent manned earth satellites. Later, doubtless, there will be extraterrestrial bases, first on the Moon, then perhaps on Mars. Beyond that the possibilities are limitless. The men who participate in these experiments will have novel experiences. Indeed, the ordinary citizen, the man who remains earth-bound, will find his life affected to a considerable extent by what is happening. As a citizen and a taxpayer he helps to plan and underwrite space programs; he will eagerly follow the events of outer space in his newspaper and his mind will be broadened by the new knowledge that the exploration of space will yield. In the space age, life will not be quite the same for anyone. The behavioral sciences can make a contribution by predicting to a certain extent the behavior of man in a space environment. These predictions must be very tentative, of course, because the environment is so novel. However, by

capitalizing on our present knowledge and by instituting certain experiments it is possible to form some generalizations which can be helpful in the planning for life in outer space.
Author
Space Exploration; Human Behavior; Aerospace Environments; Extraterrestrial Environments; Predictions

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

20050192339 NASA Glenn Research Center, Cleveland, OH, USA
Generation of Electrical Power from Stimulated Muscle Contractions Evaluated
Lewandowski, Beth; Kilgore, Kevin; Ercegovic, David B.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

This project is a collaborative effort between NASA Glenn Research Center's Revolutionary Aeropropulsion Concepts (RAC) Project, part of the NASA Aerospace Propulsion and Power Program of the Aerospace Technology Enterprise, and Case Western Reserve University's Cleveland Functional Electrical Stimulation (FES) Center. The RAC Project foresees implantable power requirements for future applications such as organically based sensor platforms and robotics that can interface with the human senses. One of the goals of the FES Center is to develop a totally implantable neural prosthesis. This goal is based on feedback from patients who would prefer a system with an internal power source over the currently used system with an external power source. The conversion system under investigation would transform the energy produced from a stimulated muscle contraction into electrical energy. We hypothesize that the output power of the system will be greater than the input power necessary to initiate, sustain, and control the electrical conversion system because of the stored potential energy of the muscle. If the system can be made biocompatible, durable, and with the potential for sustained use, then the biological power source will be a viable solution.
Author
Cybernetics; Man Machine Systems; Bionics; Biocontrol Systems; Muscular Function; Energy Conversion; Electric Generators

55
EXOBIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

20050192427 NASA Langley Research Center, Hampton, VA, USA
Nuclear Radiation Fields on the Mars Surface: Risk Analysis for Long-term Living Environment
Anderson, Brooke M.; Clowdsley, Martha S.; Qualls, Garry D.; Nealy, John E.; [2005]; 8 pp.; In English; International Conference on Environmental Systems and European Symposium on Space Environmental Control Systems, 11-14 Jul. 2005, Rome, Italy; Original contains color illustrations
Contract(s)/Grant(s): 23-090-20
Report No.(s): Paper Number 2005-01-2833; Copyright; Avail: CASI; A02, Hardcopy

Mars, our nearest planet outward from the sun, has been targeted for several decades as a prospective site for expanded human habitation. Background space radiation exposures on Mars are expected to be orders of magnitude higher than on Earth. Recent risk analysis procedures based on detailed dosimetric techniques applicable to sensitive human organs have been developed along with experimental data regarding cell mutation rates resulting from exposures to a broad range of particle types and energy spectra. In this context, simulated exposure and subsequent risk for humans in residence on Mars are examined. A conceptual habitat structure, CAD-modeled with duly considered inherent shielding properties, has been implemented. Body self-shielding is evaluated using NASA standard computerized male and female models. The background environment is taken to consist not only of exposure from incident cosmic ray ions and their secondaries, but also include the contribution from secondary neutron fields produced in the tenuous atmosphere and the underlying regolith.
Author
Mars Surface; Cosmic Microwave Background Radiation; Nuclear Radiation; Exobiology

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

20050187040 New Jersey Inst. of Tech., Newark, NJ, USA
Use of Neural Network/Dynamic Algorithms to Predict Bus Travel Times Under Congested Conditions
Chien, S. I.; Chien, M.; Liu, X.; Nov. 2003; 110 pp.; In English
Report No.(s): PB2005-106476; No Copyright; Avail: CASI; A06, Hardcopy

Automatic Passenger Counter (APC) systems have been implemented in various public transit systems to obtain various types of real-time information such as vehicle locations, travel times, and occupancies. Such information has great potential as input data for a variety of applications including performance evaluation, operations management, and service planning. In this study, a dynamic model for predicting bus arrival times is developed using data collected by a real-world APC system. The model consists of two major elements. The first one is an artificial neural network model for predicting bus travel time between time points for a trip occurring at given time-of-day, day-of-week, and weather condition. The second one is a Kalman filter based dynamic algorithm to adjust the arrival time prediction using up-to-the-minute bus location (operational) information. Test runs show that the developed model is quite powerful in dealing with variations in bus arrival times along the service route.
NTIS
Algorithms; Dynamic Models; Neural Nets; Passengers

20050187084 Siempelkamp Nukleartechnik G.m.b.H, Heidelberg, Germany
Application of a State of the Art 3D-CAD-Modeling and Simulation System for the Decommissioning of Nuclear Capital Equipment in Respect of German Prototype Spent Fuel Reprocessing Plant Karlsruhe
Schulz, M.; Boese, U.; Doering, K.; Feb. 2002; 12 pp.; In English
Report No.(s): DE2005-827932; No Copyright; Avail: Department of Energy Information Bridge

Siempelkamp Nukleartechnik GmbH is engaged in the optimization of decommissioning processes for several years. With respect of the complexity of the projects, the time frame and the budget it is necessary to find more effective ways to handle those tasks in the near future. The decommissioning and dismantling will be achieved in six steps taking into account that some processing equipment can be dismantled before and the rest only after the High Active Liquid Waste Concentrate (HAWC) has been vitrified approximately by mid of 2005. After the successful beginning of the remote dismantling of the main process cells from March 2000, the next remote dismantling project at the WAK was initiated April 2000.
NTIS
Computer Aided Design; Decommissioning; Prototypes; Reclamation; Simulation; Spent Fuels

20050187087 Carnegie-Mellon Univ., Pittsburgh, PA USA
Antiplane Shear Flows in Visco-plastic Solids Exhibiting Isotropic and Kinematic Hardening
Greenberg, J. M.; Owen, D. R.; January 2003; 28 pp.; In English
Report No.(s): DE2005-821262; No Copyright; Avail: Department of Energy Information Bridge

The authors consider antiplane shearing motions of an incompressible visco-plastic solid. The particular constitutive equation employed assumes that the stress tensor has an elastic component and a component which can exhibit hysteresis. The model exhibits both kinematic and isotropic hardening. Our results consist of a set of energy type estimates for the resulting system, L2 contractivity estimates for the solution operator, and finally an analysis of the approach of our system to a rate independent model as a distinguished parameter describing our flow rule approaches zero. We also include some computational results for simple piecewise constant data.
NTIS
Isotropy; Kinematics; Mathematical Models; Plastic Properties; Shear Flow; Solids

20050187089 Department of Energy, Washington, DC USA
Image-Based Visual Servoing for Robotic Systems: A Nonlinear Lyapunov-Based Control Approach
January 2004; 8 pp.; In English
Report No.(s): DE2005-835391; No Copyright; Avail: Department of Energy Information Bridge

The objective of this project is to enable current and future EM robots with an increased ability to perceive and interact

with unstructured and unknown environments through the use of camera-based visual servo controlled robots. The scientific goals of this research are to develop a new visual servo control methodology that: (1) adapts for the unknown camera calibration parameters (e.g., focal length, scaling factors, camera position and orientation) and the physical parameters of the robotic system (e.g., mass, inertia, friction), (2) compensates for unknown depth information (extract 3D information from the 2D image), and (3) enables multi-uncalibrated cameras to be used as a means to provide a larger field-of-view. Nonlinear Lyapunov-based techniques are being used to overcome the complex control issues and alleviate many of the restrictive assumptions that impact current visual servo controlled robotic systems.
NTIS
Computer Vision; Image Analysis; Image Processing; Nonlinearity; Robotics; Robots

20050187098 Carnegie-Mellon Univ., Pittsburgh, PA USA
Rigorous Treatment of a Follow-the-leader Traffic Model with Traffic Lights Present
Argall, B.; Cheleshkin, E.; Greenberg, J. M.; Hinde, C.; Lin, P. J.; January 2005; 34 pp.; In English
Report No.(s): DE2005-821218; No Copyright; Avail: Department of Energy Information Bridge
Traffic flow on a unidirectional roadway in the presence of traffic lights is modeled. Individual car responses to green, yellow, and red lights are postulated and these result in rules governing the acceleration and deceleration of individual cars. The essence of the model is that only specific cars are directly affected by the lights. The other cars behave according to simple follow-the-leader rules which limit their speed by the spacing between it and the car directly ahead. The model has a number of desirable properties; namely cars do not run red lights, cars do not smash into one another, and cars exhibit no velocity reversals. In a situation with multiple lights operating in-phase we get, after an initial startup period, a constant number of cars through each light during any green-yellow period. Moreover, this flux is less by one or two cars per period than the flux obtained in discretized versions of the idealized Lighthill, Whitham, Richards model which allows for infinite accelerations. ‘This research was partially supported by the Applied Mathematical Sciences Program, U.S. Department of Energy and by the US. National Science Foundation.
NTIS
Luminaires; Mathematical Models; Traffic

20050187099 Mississippi State Univ., Mississippi State, MS, USA
SIAM Conference on Geometric Design and Computing
Mar. 2002; 58 pp.; In English; SIAM Conference on Geometric Design and Computing., November 5 - 8, 2001. Final Technical Report, Sacramento, California
Report No.(s): DE2005-821108; No Copyright; Avail: Department of Energy Information Bridge
The SIAM Conference on Geometric Design and Computing attracted 164 domestic and international researchers, from academia, industry, and government. It provided a stimulating forum in which to learn about the latest developments, to discuss exciting new research directions, and to forge stronger ties between theory and applications.
NTIS
Computer Aided Design; Conferences; California

20050189219 Los Alamos National Lab., NM USA
Concepts of Model Verification and Validation
January 2005; 46 pp.; In English
Report No.(s): DE2005-835920; LA-14167-MS; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
Computer Programs; Proving

20050189259 Pacific Northwest National Lab., Richland, WA, USA, Oregon Graduate Inst. of Science and Technology, Beaverton, OR, USA
Shifting Contexts in Invisible Computing Environments
McGee, D. R.; Pavel, M.; Cohen, P. R.; January 2005; 8 pp.; In English
Report No.(s): DE2005-15010324; No Copyright; Avail: Department of Energy Information Bridge
Invisible computing systems are highly context-dependent. Consequently, the influence that language has on contextual interpretation cannot be ignored by such systems. Rather, once language and other forms of human action are perceived by a system, its interpretative processes will of necessity be context-dependent. As an example, we illustrate how people simply

and naturally create new contexts for interpretation by creating new names and referring expressions. We then describe Rasa, a mixed-reality system that invisibly observes and understands how users in a military command post create such contexts as part of the process of maintaining situational awareness. Rasa augments both the commander's map and the Post-it notes pasted on it, which represent units in the field, with multimodal language, thereby allowing paper-based tools to interact with digital information. Finally, we argue that architectures for such context-aware systems must reduce the inherent ambiguity and uncertainty through fusion and other means.
NTIS
Architecture (Computers); Digital Data; Situational Awareness

20050192041 Asian Technology Information Program, Albuquerque, NM, USA
Proposal to Provide Asian Science and Technology Information
Jun. 19, 2003; 16 pp.; In English
Report No.(s): DE2005-821153; No Copyright; Avail: Department of Energy Information Bridge
The focus of this program, was to address those scientific, technical, market, and policy activities which are supported/conducted by Japanese and other relevant Asian organizations pursing research, development and/or manufacturing in high performance computing and communications (HPC), networking, and related sectors, as well as, relevant specialized end applications. The scope of the programs and activities were focused on establishing direct and timely analyses of relevant scientific and technical trend and developments.
NTIS
Information Dissemination; Research and Development; Technologies; Technology Transfer

20050192068 General Accounting Office, Washington, DC, USA
Information Security: Federal Agencies Need to Improve Controls over Wireless Networks
May 2005; 36 pp.; In English
Report No.(s): PB2005-106863; GAO-05-383; No Copyright; Avail: CASI; A03, Hardcopy
The use of wireless networks is becoming increasingly popular. Wireless networks extend the range of traditional wired networks by using radio waves to transmit data to wireless-enabled devices such as laptops. They can offer federal agencies many potential benefits but they are difficult to secure. GAO was asked to study the security of wireless networks operating within federal facilities. This report (1) describes the benefits and challenges associated with securing wireless networks, (2) identifies the controls available to assist federal agencies in securing wireless networks, (3) analyzes the wireless security controls reported by each of the 24 agencies under the Chief Financial Officers (CFO) Act of 1990, and (4) assesses the security of wireless networks at the headquarters of six federal agencies in Washington, D.C.
NTIS
Information Systems; Security; Wireless Communication

20050192283 General Accounting Office, Washington, DC, USA
Information Security: Federal Deposit Insurance Corporation Needs to Sustain Progress
May 2005; 26 pp.; In English
Report No.(s): PB2005-106867; GAO-05-486; No Copyright; Avail: CASI; A03, Hardcopy
The Federal Deposit Insurance Corporation (FDIC) relies extensively on computerized systems to support its financial and mission-related operations. As part of GAO's audit of the calendar year 2004 financial statements for the three funds administered by FDIC, GAO assessed (1) the progress FDIC has made in correcting or mitigating information system control weaknesses identified in our audits for calendar years 2002 and 2003 and (2) the effectiveness of the corporation's information system general controls.
NTIS
Deposits; Information Systems; Insurance (Contracts); Security

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

20050186975 Committee on Aeronautical and Space Sciences (U.S. Senate), Washington, DC, USA
Space Law and the Fourth Dimension of Our Age
Keating, Kenneth B.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 83-90; In English; See also 20050186958; Copyright; Avail: Other Sources

A striking parallel may be drawn between the physical world in which we move and the philosophical world which guides our affairs. In each of these worlds we have encountered a new dimension. In our physical world we stand on the brink of Space, looking down the long corridors of time to an unending region where there is no East or West, no up or down, no weight, no wind, no sound. We are about to cast off into this mysterious 'space-time continuum' [1] both to satisfy our curiosity and to enhance our position on Earth. Taking the long view it may well be, as one of America's foremost scientists asserts, that man at present is merely creating a new 'chink' in his atmospheric curtain through which to extend his meager knowledge of the universe [2]. Nevertheless, this tentative beginning, _ new physical dimension being opened by missile and satellite technology, has created urgent new social problems on our immediate planet--problems which should also make us aware of the rapid materialization of a new philosophic dimension. For lack of a better word, we might call that dimension 'Tempo'. Tempo connotes relative rates of speed or movement, the distinguishing characteristics of motion, or (more pertinently here) the rhythm of events. And this is precisely the new dimension which our 20th century civilization must take into account if it is to progress, or even survive. The accelerating momentum of history, the figurative shrinking of the globe, the telescoping of time--these things now form a major component which must be included in any human equation designed to solve the social conflicts of the future.
Author
Space Law; Universe; Planetary Protection

20050188512 NASA Lewis Research Center, Cleveland, OH, USA
Reconfigurable Data Communications Packet-Switch Emulation Test Bed Demonstrated
Chu, Pong P.; Jones, Robert E.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Communications Technology Division at the NASA Lewis Research Center has an ongoing program to develop advanced switching and routing technology concepts for future satellite onboard processing systems. Through a university grant as a part of this research, the Cleveland State University is using a flexible reconfigurable data communications packet switch emulation test bed to investigate packet switching techniques. Because of the switching speed and protocol complexity, implementing a data communications network is a tremendous task. Various alternatives should be carefully studied and evaluated in the development stage so that the optimal system configuration can be obtained and implemented later. Therefore, it is desirable to predict the performance of the network before it is actually constructed. This is especially true in the case of satellite systems. In the past, theoretical analysis, software simulation, and prototyping were used to evaluate performance. However, each method has its drawback. There are basic tradeoffs among accuracy, cost, and required evaluation time. No method is completely satisfactory.
Derived from text
Data Transmission; Communication Networks; Packet Switching

61
COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20050188511 NASA Lewis Research Center, Cleveland, OH, USA
High-Performance, Low-Complexity Codes Researched for Communication Channels
Kwatra, Subhash C.; Jones, Robert E.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Lewis Research Center s Communications Technology Division has an ongoing program in the development of

efficient channel coding schemes for satellite communications applications. Through a university grant, as a part of this research, the University of Toledo is investigating the performance of turbocodes, which use parallel concatenation of non-systematic convolutional encoders with an interleaver. The error correcting capacity of these codes is close to the Shannon limit. The research emphasis is on the development of low-complexity, but higher rate (greater than one half), turbocodes and on the iterative decoding of block codes.
Derived from text
Coding; Channels (Data Transmission); Computer Programming

20050188543 NASA Lewis Research Center, Cleveland, OH, USA
CARES/Life Ceramics Durability Evaluation Software Enhanced for Cyclic Fatigue
Nemeth, Noel N.; Powers, Lynn M.; Janosik, Lesley A.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The CARES/Life computer program predicts the probability of a monolithic ceramic component's failure as a function of time in service. The program has many features and options for materials evaluation and component design. It couples commercial finite element programs--which resolve a component's temperature and stress distribution--to reliability evaluation and fracture mechanics routines for modeling strength-limiting defects. The capability, flexibility, and uniqueness of CARES/Life have attracted many users representing a broad range of interests and has resulted in numerous awards for technological achievements and technology transfer. Recent work with CARES/Life was directed at enhancing the program s capabilities with regards to cyclic fatigue. Only in the last few years have ceramics been recognized to be susceptible to enhanced degradation from cyclic loading. To account for cyclic loads, researchers at the NASA Lewis Research Center developed a crack growth model that combines the Power Law (time-dependent) and the Walker Law (cycle-dependent) crack growth models. This combined model has the characteristics of Power Law behavior (decreased damage) at high R ratios (minimum load/maximum load) and of Walker law behavior (increased damage) at low R ratios. In addition, a parameter estimation methodology for constant-amplitude, steady-state cyclic fatigue experiments was developed using nonlinear least squares and a modified Levenberg-Marquardt algorithm. This methodology is used to give best estimates of parameter values from cyclic fatigue specimen rupture data (usually tensile or flexure bar specimens) for a relatively small number of specimens. Methodology to account for runout data (unfailed specimens over the duration of the experiment) was also included.
Author
Ceramics; Computer Programs; Fatigue Life

20050189156 Naval Research Lab., Bay Saint Louis, MS USA
DIOPS: A PC-Based Wave, Tide and Surf Prediction System
Allard, Richard; Dykes, James; Kaihatu, James; Wakeham, Dean; Jan. 2005; 7 pp.; In English
Report No.(s): AD-A432398; NRL/PP/7320-04-5013; No Copyright; Avail: CASI; A02, Hardcopy

The Distributed Integrated Ocean Prediciton System (DIOPS) is a PC-based wave tide and surf prediction system designed to provide DoD accurate and timely surf predictions for essentially any world-wide location. Regional and coastal wave predictions are made by the Simulating Waves Nearshore (SWAN) wave module that is typically initialized by offshore directional wave spectra from the Fleet Numerical Meteorological and Oceanography Center (FNMOC). Tide and storm surge predictions are made by PCTIDES, a relocatable 2-D barotropic ocean model that can assimilate tidal constituent data. A one-dimensional surf model, SURF3. 2 generates surf predictions based on wave and tidal information from SWAN and PCTIDES. Wind forcing obtained from FNMOC is used to force all DIOPS models. Water levels from PCTIDES are used to adjust bathymetry in the wave and surf modules. The Dynamic Information Architecture System developed by Argonne National Laboratory provides the object-oriented framework that allows the models to exchange information with each other. DIOPS has been loosely coupled with the Delft3D modeling system for 2-dimensional surf predictions to give the U.S. Navy a new capability to predict the location of rip-tides, provided high-resolution (scales of meters) bathymetry is available.
DTIC
Computer Programs; Ocean Models; Prediction Analysis Techniques; Tides

20050189239 West Virginia Univ., Morgantown, WV, USA
Evaluation of Roof Bolting Requirements Based on In-Mine Roof Bolter Drilling. Quarterly Technical Progress Report
Peng, S. S.; Sep. 15, 2004; 14 pp.; In English
Report No.(s): DE2005-836111; No Copyright; Avail: Department of Energy Information Bridge

In this quarter, the field, theoretical and programming works have been performed toward achieving the research goals set in the proposal. The main accomplishments in this quarter included: (1) two more sets of field tests have been conducted in an underground coal mine, (2) optimization studies of the control parameters have been conducted, (3) method to use torque to thrust ratio as indicator of rock relative hardness has also been explored, and (3) about 97% of the development work for the roof geology mapping program, MRGIS, has completed, (4) A special version of the geology mapping program for a limestone mine has been developed. The field test for the software and hardware has been successfully finished.
NTIS
Collapse; Drilling; Geology; Information Systems; Mining; Roofs; Safety

20050192040 Navy Personnel Research Studies and Technology, Millington, TN USA
Technology Review of Multi-Agent Systems and Tools
Fang, Frank; Reed, Elaine; Dickason, David K.; Simien, H. J.; Wulff, Michelle L.; Jun. 2005; 100 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): 98-D-9501-DO7J86
Report No.(s): AD-A434259; NPRST-TN-05-6; No Copyright; Avail: CASI; A05, Hardcopy

This document provided a review of current intelligent multi-agent technologies. It presents agent frameworks and agent construction toolkits available in the market today. The Navy Web-based Marketplace is a suitable environment for intelligent multi-agent technologies, where a distributed peer-to-peer process is the essential model with inter-agent communications and coordination. Reasoning with rules of thumb and heuristics are currently common practice as commands define their preferences and detailers make job assignments. This report provides recommendations for agent system development, agent framework, inference engines, and agent construction toolkits. A high-level system architecture is proposed to meet Navy Web-based Marketplace functional requirements. There are three major components of the proposal: (1) a web services-based, front-end at the presentation layer that provides friendly access for Sailors, commands, detailers, and counselors; (2) a workflow layer that provides support for business processes of the various user groups; and (3) and intelligent agent layer that provides the framework through which the agents communicate and negotiate for optimal matches between available Navy jobs and Sailors.
DTIC
Client Server Systems; Computer Systems Design; Human-Computer Interface

20050192373 NASA Glenn Research Center, Cleveland, OH, USA
Interactive Software System Developed to Study How Icing Affects Airfoil Performance (Phase 1 Results)
Choo, Yung K.; Vickerman, Mary B.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

SmaggIce (Surface Modeling and Grid Generation for Iced Airfoils), which is being developed at the NASA Glenn Research Center at Lewis Field, is an interactive software system for data probing, boundary smoothing, domain decomposition, and structured grid generation and refinement. All these steps are required for aerodynamic performance prediction using structured, grid-based computational fluid dynamics (CFD), as illustrated in the following figure. SmaggIce provides the underlying computations to perform these functions, as well as a graphical user interface to control and interact with them, and graphics to display the results.
Derived from text
Aircraft Icing; Airfoils; Computer Programs; Software Development Tools

20050192375 NASA Glenn Research Center, Cleveland, OH, USA, DYNACS Engineering Co., Inc., USA
Software Released by LEWICE 2.0 Ice Accretion Software Development Project
Potapczuk, Mark G.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Computational icing simulation methods are making the transition from the realm of research to commonplace use in design and certification. As such, standards of software management, design, validation, and documentation must be adjusted to accommodate the increased expectations of the user community with respect to accuracy, reliability, capability, and usability. With this in mind, in collaboration with Glenn's Engineering Design and Analysis Division, the Icing Branch of the NASA Glenn Research Center at Lewis Field began a software improvement project focused on the two-dimensional ice accretion simulation tool LEWICE. This project is serving as an introduction to the concepts of software management and is intended to serve as a pilot project for future icing simulation code development. The LEWICE 2.0 Software Development

Project consisted of two major elements: software management and software validation. The software management element consisted of identifying features of well-designed and well-managed software that are appropriate for an analytical prediction tool such as LEWICE and applying them to a revised version of the code. This element included tasks such as identification of software requirements, development and implementation of coding standards, and implementation of software revision control practices. With the application of these techniques, the LEWICE ice accretion code became a more stable and reliable software product. In addition, the lessons learned about software development and maintenance can be factored into future software projects at the outset. The software validation activity was an integral part of our effort to make LEWICE a more accurate and reliable analysis tool. Because of the efforts taken to extensively validate this software, LEWICE 2.0 is more robust than previous releases and can reproduce results accurately across several computing platforms. It also differs from previous versions in the extensive quantitative comparisons of its results with a data base of ice shapes that were generated in Glenn's Icing Research Tunnel. The results of the shape comparisons were analyzed to determine the range of meteorological conditions under which LEWICE 2.0 is within the repeatability found for ice shapes obtained from experiments. These comparisons show that the average variation of LEWICE 2.0 from experimental data is 7.2 percent, whereas the overall variability of the experimental data is 2.5 percent. The LEWICE 2.0 Software Development Project resulted in the release, at the recent Icing Branch LEWICE Workshop, of a more useful and robust analysis tool than was previously available to the icing community. The lessons learned from this project will be applied to the Icing Branch s future software development efforts.
Author
Software Engineering; Computerized Simulation; Ice Formation; Software Development Tools

20050192392 NASA Glenn Research Center, Cleveland, OH, USA
CEMCAN Software Enhanced for Predicting the Properties of Woven Ceramic Matrix Composites
Murthy, Pappu L. N.; Mital, Subodh K.; DiCarlo, James A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Major advancements are needed in current high-temperature materials to meet the requirements of future space and aeropropulsion structural components. Ceramic matrix composites (CMC's) are one class of materials that are being evaluated as candidate materials for many high-temperature applications. Past efforts to improve the performance of CMC's focused primarily on improving the properties of the fiber, interfacial coatings, and matrix constituents as individual phases. Design and analysis tools must take into consideration the complex geometries, microstructures, and fabrication processes involved in these composites and must allow the composite properties to be tailored for optimum performance. Major accomplishments during the past year include the development and inclusion of woven CMC micromechanics methodology into the CEMCAN (Ceramic Matrix Composites Analyzer) computer code. The code enables one to calibrate a consistent set of constituent properties as a function of temperature with the aid of experimentally measured data.
Author
Computerized Simulation; Computer Programs; Ceramic Matrix Composites; Woven Composites

62
COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

20050189188 Naval Observatory, Washington, DC USA
Reflections on Ten Years of Network Time Service
Schmidt, Richard; Jan. 2005; 17 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434455; No Copyright; Avail: Defense Technical Information Center (DTIC)

The year 2004 marks the 10th anniversary since the start of U.S. Naval Observatory (USNO) time dissemination on the Internet using the Network Time Protocol (NTP). In 1994, our service was inauspicious: two 50MHz/32MB servers on a 56kb WAN link handling one packet every 17 seconds. Today, three servers in Washington, D.C., process over five thousand packets per second from millions of clients across the U.S. and 63 other nations. At the USNO Alternate Master Clock at Schriever AFB, Colorado, two additional servers provide NTP. Seventeen USNO servers with embedded GPS provide U.S. regional coverage from Alaska to Hawaii, from Washington state to Florida, from southern California to Maine. For the past 6 years, USNO has provided time service on the SIPRNET from Washington, D. C., and Schriever AFB. SIPRNET timing will soon expand with remote SAASM GPS servers. Throughout its history USNO, with the assistance of cooperating agencies, has

provided free public time dissemination, from time balls to telegraphic time, wireless broadcasts, telephone time, LORAN, GPS, and Internet time. NTP is lightweight, reliable, accurate, and robust. Freely distributed, it has been ported to numerous devices and operating systems. The architecture of NTP is permanently in evolutionary development and in remote system maintenance.
DTIC
Wide Area Networks; Protocol (Computers); Navy

20050192362 NASA Glenn Research Center, Cleveland, OH, USA
Internet Protocol Suite Enhanced for Satellite-Based Networks
Allman, Mark A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Research conducted by the Satellite Networks and Architectures Branch of the NASA Glenn Research Center at Lewis Field as well as by GTE Internetworking has increased the performance of the standard Internet protocol efficiency over long-delay satellite channels (ref. 1). These protocol extensions will enable efficient operation of standard off-the-shelf networking software in NASA s network of space-based assets (e.g., the International Space Station and data-gathering satellites). The work at Glenn focused on two areas. The first was the startup phase of a transfer between two computers. This period in a transfer has been shown to use the available network resources inefficiently. We experimented with several ways to improve the network utilization during this period (refs. 2 and 3). The second area was making the protocols estimate the available bandwidth of the network path so that the transfer could make better use of the available resources (ref. 4). These studies have shown that transfer times improve when the mechanisms developed at Glenn are used. Finally, Glenn funded GTE Internetworking to incorporate a 'pacing' algorithm into the standard Internet protocols. This protocol extension provides high performance over a long-delay-based network, while minimizing the impact of these transfers on protocols were used instead of the standard protocols.
Author
Protocol (Computers); Internets

63
CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

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

20050188522 NASA Lewis Research Center, Cleveland, OH, USA
High Reliability Engine Control Demonstrated for Aircraft Engines
Guo, Ten-Huei; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

For a dual redundant-control system, which is typical for short-haul aircraft, if a failure is detected in a control sensor, the engine control is transferred to a safety mode and an advisory is issued for immediate maintenance action to replace the failed sensor. The safety mode typically results in severely degraded engine performance. The goal of the High Reliability Engine Control (HREC) program was to demonstrate that the neural-network-based sensor validation technology can safely operate an engine by using the nominal closed-loop control during and after sensor failures. With this technology, engine performance could be maintained, and the sensor could be replaced as a conveniently scheduled maintenance action.
Author
Engine Control; Neural Nets; Control Systems Design; Aircraft Engines; Aircraft Reliability; Redundancy

64
NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20050189201 NASA Lewis Research Center, Cleveland, OH, USA
Space-Time Conservation Element and Solution Element Method Being Developed
Chang, Sin-Chung; Himansu, Ananda; Jorgenson, Philip C. E.; Loh, Ching-Yuen; Wang, Xiao-Yen; Yu, Sheng-Tao; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The engineering research and design requirements of today pose great computer-simulation challenges to engineers and scientists who are called on to analyze phenomena in continuum mechanics. The future will bring even more daunting

challenges, when increasingly complex phenomena must be analyzed with increased accuracy. Traditionally used numerical simulation methods have evolved to their present state by repeated incremental extensions to broaden their scope. They are reaching the limits of their applicability and will need to be radically revised, at the very least, to meet future simulation challenges. At the NASA Lewis Research Center, researchers have been developing a new numerical framework for solving conservation laws in continuum mechanics, namely, the Space-Time Conservation Element and Solution Element Method, or the CE/SE method. This method has been built from fundamentals and is not a modification of any previously existing method. It has been designed with generality, simplicity, robustness, and accuracy as cornerstones. The CE/SE method has thus far been applied in the fields of computational fluid dynamics, computational aeroacoustics, and computational electromagnetics. Computer programs based on the CE/SE method have been developed for calculating flows in one, two, and three spatial dimensions. Results have been obtained for numerous problems and phenomena, including various shock-tube problems, ZND detonation waves, an implosion and explosion problem, shocks over a forward-facing step, a blast wave discharging from a nozzle, various acoustic waves, and shock/acoustic-wave interactions. The method can clearly resolve shock/acoustic-wave interactions, wherein the difference of the magnitude between the acoustic wave and shock could be up to six orders. In two-dimensional flows, the reflected shock is as crisp as the leading shock. CE/SE schemes are currently being used for advanced applications to jet and fan noise prediction and to chemically reacting flows.
Derived from text
Space-Time CE/SE Method; Computerized Simulation

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20050189154 Military Academy, West Point, NY USA
Network-Centric System Implications for the Hypersonic Interceptor System
West, Paul D.; May 2005; 51 pp.; In English
Report No.(s): AD-A434078; DSE-TR-0547; No Copyright; Avail: CASI; A04, Hardcopy

This report identifies the qualities and attributes of network-centric (NCS), describes a taxonomy of 13 critical NCS risk factors, and outlines a value-based model for NCS risk management, all as they affect the operation of a hypersonic interceptor (HSI) system. Successful employment of an HSI system requires a thorough integration of operations into the larger NCS super-system. Required capabilities previously identified for an HSI indicate the intent for this system is to function in full collaboration with the Joint Exercise Support System Intelligence Module(JIM), Unit of Employment (UE), and Unit of Action (UA) forces, which will operate in a network-centric framework. Based on these required capabilities and the common NCS factors, it is recommended that the Hypersonic Interceptor IPT identify specific measures of effectiveness (MOE) relevant for system risk management in an NCS environment and incorporate these measures and the methodology described in this report into the system life-cycle management plan. Specific actions to implement these recommendations include the development of a decision support tool to assess key stakeholder risk profiles and to model attribute weights in pre- and ongoing HSI operations, development of MOE to assess ongoing and post-operations analysis, and collaboration with engineers and operators of related NCS node programs.
DTIC
Hypersonics; Operations Research; Systems Management

20050189155 Military Academy, West Point, NY USA
A Validation Methodology for Human Behavior Representation Models
Goerger, Simon R.; McGinnis, Michael L.; Darken, Rudolph P.; May 2005; 100 pp.; In English
Report No.(s): AD-A433696; DSE-R-0531; No Copyright; Avail: CASI; A05, Hardcopy

The Department of Defense relies Heavily on mathematical models and computer simulations to analyze and acquire new weapon systems. Models and simulations help decision-makers understand the differences between systems and provide insights into the implications of weapon system tradeoffs. Given this key role, the credibility of simulations is paramount. For combat models, this is gained through the verification, validation, and accreditation process required of DOD analytical models prior to their use in weapon system acquisition and other studies. The nature of nondeterministic human behavior makes validation of models of human behavior representation contingent on the judgments of subject matter experts that are routinely acquired using a face validation methodology. In an attempt to better understand the strengths and weaknesses of assessing human behavior representation using experts and the face validation methodology, the authors conducted

experiments to identify issues critical to utilizing human experts for the purpose of ascertaining ways to enrich the validation process for models relying on human behavior representation. The research was limited to the behaviors of individuals engaged in close combat in an urban environment. This paper presents the study methodology, data analysis, and recommendations for mitigating attendant problems with validation of human behavior representation models.
DTIC
Cognition; Computerized Simulation; Human Behavior; Mathematical Models; Psychology

20050189160 Rand Arroyo Center, Santa Monica, CA USA
The Weapons Mix Problem: A Math Model to Quantify the Effects of Internetting of Fires to the Future Force
Pernin, Christopher G.; Moore, Louis R.; Jan. 2005; 38 pp.; In English
Contract(s)/Grant(s): DASW01-01-C-0003
Report No.(s): AD-A434563; RAND/TR-170-A; No Copyright; Avail: CASI; A03, Hardcopy

The goal of this report is to describe a method for answering the question, How might internetted weapons be best employed? Additionally, this study provided a better understanding of the IOF process and a means to quantify its relationship to combat outcome. An important aspect of implementing the IOF concept will be to discover how best to allocate fire missions from a collection of shooters on a network. This report describes the design and use of an analytical tool to assist in determining the allocation of weapons to targets. Proof-of-principle examples that demonstrate the model's utility are given, along with observations and a discussion on the way ahead for this methodology. The tool was designed to be simple, unencumbered, and transparent, enabling the customer to use it quickly to develop insights into weapon allocation and other aspects of future battle command systems. This work should be of interest to those involved in C4ISR design, development, and system acquisition planning for the Army's Future Force.
DTIC
Allocations; Fires; Mathematical Models; Networks; Software Development Tools

67
THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

20050189189 University of Eastern Illinois, Charleston, IL USA
A Parametric Model for Large Scale Agent Systems
Agha, Gul; Sen, Koushik; Apr. 2005; 422 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-00-2-0586; DARPA ORDER-K545; Proj-TASK
Report No.(s): AD-A434354; AFRL-IF-RS-TR-2005-151; No Copyright; Avail: Defense Technical Information Center (DTIC)

The goal of this project was to develop new techniques for the construction, description, and analysis of multi-agent systems. The characteristics of systems being addressed include a high degree of non-determinism (resulting form a large number of interactions) and unpredictability of the environment in which the agents operate. Specifically, we implemented tools for building robust and dependable large-scale multi-agent systems and studied methods for predicting and analyzing the behaviors of such systems. The project developed coordination methods for systems consisting of large numbers of agents.
DTIC
Mathematical Models; Large Scale Integration

70
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics, 90 Astrophysics*, or *92 Solar Physics*.

20050187034 General Accounting Office, Washington, DC, USA
Information Security: Radio Frequency Identification Technology in the Federal Government
May 2005; 46 pp.; In English
Report No.(s): PB2005-106875; GAO-05-551; No Copyright; Avail: CASI; A03, Hardcopy

Radio frequency identification (RFID) is an automated datacapture technology that can be used to electronically identify, track, and store information contained on a tag that is attached to or embedded in an object, such as a product, case, or pallet. Federal agencies have begun implementation of RFID technology, which offers them new capabilities and efficiencies in operations. Accordingly, GAO was requested to discuss considerations surrounding RFID technology implementation in the federal government. Specifically, GAO was asked to (1) provide an overview of the technology; (2) identify the major initiatives at federal agencies that use or propose to use the technology; (3) discuss the current standards, including those for interoperability, that exist; (4) discuss potential legal issues that the 24 Chief Financial Officer (CFO) Act agencies have identified in their planning for technology implementation; and (5) discuss security and privacy considerations surrounding the technology and the tools and practices available to mitigate them.
NTIS
Radio Frequencies; Identifying; Security

20050187036 Department of Energy, Washington, DC USA
Trends in the Design of Front-end Systems for Room Temperature Solid State Detectors
Manfredi, P. F.; Re, V.; January 2004; 14 pp.; In English
Report No.(s): DE2005-836963; No Copyright; Avail: Department of Energy Information Bridge

The paper discusses the present trends in the design of low-noise front-end systems for room temperature semiconductor detectors. The technological advancement provided by submicron CMOS and BiCMOS processes is examined from several points of view. The noise performances are a fundamental issue in most detector applications and suitable attention is devoted to them for the purpose of judging whether or not the present processes supersede the solutions featuring a field-effect transistor as a front-end element. However, other considerations are also important in judging how well a monolithic technology suits the front-end design. Among them, the way a technology lends itself to the realization of additional functions, for instance, the charge reset in a charge-sensitive loop or the time-variant filters featuring the special weighting functions that may be requested in some applications of CdTe or CZT detectors.
NTIS
Hardness; Resistors; Room Temperature; Semiconductors (Materials); Solid State Devices; Sound Waves; Trends

20050187037 Istituto Nazionale di Fisica Nucleare, Rome, Italy, Thomas Jefferson National Accelerator Facility, Newport News, VA, USA
Evaluation of the Higher Twist Contribution to the Moments of Proton Structure Functions F2 and G1
Osipenko, M.; Simula, S.; Ricco, G.; Fedotov, G.; January 2005; 10 pp.; In English
Report No.(s): DE2005-836845; No Copyright; Avail: Department of Energy Information Bridge

We performed the measurement of the inclusive electron scattering off the proton in the resonance region (W\h2.5 GeV) at momentum transfer Q2 below 4.5 (GeV/c)(sup 2) with the CLAS detector. The large acceptance of CLAS provided an access to a large, continuous two-dimensional kinematic domain in Q2 and x, allowing therefore an integration of the data at fixed Q2 over x-interval. The covered x-interval at each measured Q2 value is sufficient for an evaluation of the higher moments (n\g2). From these data we extracted the structure function F2 and, by including other world data, we studied the Q2 evolution of its moments, Mn(Q2), in order to estimate the higher twist contributions. A similar experiment with polarized proton target is completed at CLAS. These new data allow an accurate determination of higher moments of the proton structure function g1. A preliminary phenomenological analysis indicates an excess of the higher twist contribution in the spin-dependent structure function with respect to the spin-independent one.
NTIS
Elementary Particles; Protons

20050187045 Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA
Triquark-Diquark Models of a theta(1540)
Dudek, J.; January 2005; 8 pp.; In English
Report No.(s): DE2005-836062; No Copyright; Avail: Department of Energy Information Bridge

The enhancement in the flavor exotic NK channel seen by a number of experiments has been interpreted as a resonant pentaquark state, the (Theta)(sup +)(1540). Theoretical efforts to understand its structure, with the aim of explaining both the low mass and small decay width, have thrown up the possibility of a triquark-diquark P-wave correlation. We will discuss the constituent quark model study of Karliner/Lipkin and suggest that their P-wave excitation energy is an under estimate, a more plausible value raising the (Theta) mass in this model to more than 1700 MeV. We also propose on rather general grounds that

these correlated quark models give rise to not only exotic baryon states, but also exotic meson states, in particular the strangeness +2, isoscalar (var-theta)(sup +) which will decay to K(sup +) K(sup 0).
NTIS
Baryons; Quark Models

20050187058 Maryland Univ., College Park, MD, USA, California Univ., Davis, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
Improved Single Sector Supersymmetry Breaking
Luty, M. A.; Terning, J.; January 1999; 40 pp.; In English
Report No.(s): DE2005-836542; UMDHEP-99-68; LBNL-42601; No Copyright; Avail: Department of Energy Information Bridge

Building on recent work by N. Arkani-Hamed and the present authors, we construct realistic models that break supersymmetry dynamically and give rise to composite quarks and leptons, all in a single strongly-coupled sector. The most important improvement compared to earlier models is that the second-generation composite states correspond to dimension-2 meson operators in the ultraviolet. This leads to a higher scale for flavor physics, and gives a completely natural suppression of flavor-changing neutral currents. We also construct models in which the hierarchy of Yukawa couplings is explained by the dimensionality of composite states. These models provide an interesting and viable alternative to gravity- and gauge-mediated models. The generic signatures are unification of scalar masses with different quantum numbers at the compositeness scale, and lighter gaugino, Higgsino, and third-generation squark and slepton masses. We also analyze large classes of models that give rise to both compositeness and supersymmetry breaking, based on gauge theories with confining, fixed-point, or free-magnetic dynamics.
NTIS
Supersymmetry; Gauge Theory; Yukawa Potential

20050187077 Gordon Research Conferences, Inc., Kingston, RI, USA
Gordon Research Conference on 2003 Atomic Physics Gordon Conference. Final Progress Report. Held at Tilton, New Hampshire on June 15-20, 2003
January 2003; 12 pp.; In English
Report No.(s): DE2005-829826; No Copyright; Avail: Department of Energy Information Bridge

The Gordon Research Conference (GRC) on 2003 Atomic Physics Gordon Conference was held at Tilton School in Tilton, NH, June 15-20, 2003. The Conference was well-attended with 135 participants (attendees list attached). The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both U.S. and foreign scientists, senior researchers, young investigators, and students.
NTIS
Atomic Physics; Conferences

20050187078 Gordon Research Conferences, Inc., Kingston, RI, USA
Gordon Research Conference on Quantum Control of Light and Matter. Final Progress Report. Held at South Hadley, Massachusetts on August 3-8, 2003
January 2003; 14 pp.; In English
Report No.(s): DE2005-829859; No Copyright; Avail: Department of Energy Information Bridge

The Gordon Research Conference (GRC) on Gordon Research Conference on Quantum Control of Light and Matter - August 3-8, 2003 was held at Mount Holyoke College, South Hadley, MA, August 3-8, 2003. The Conference was well-attended with 126 participants (attendees list attached). The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both U.S. and foreign scientists, senior researchers, young investigators, and students. In designing the formal speakers program, emphasis was placed on current unpublished research and discussion of the future target areas in this field. There was a conscious effort to stimulate lively discussion about the key issues in the field today.
NTIS
Conferences; Quantum Mechanics

20050187079 Gordon Research Conferences, Inc., Kingston, RI, USA

Gordon Research Conference on 2003 Organometallic Chemistry Gordon Conference. Final Progress Report. Held in Newport, Rhode Island on July 15-20, 2003

January 2003; 14 pp.; In English; Gordon Research Conference on 2003 Organometallic Chemistry Gordon Conference. Final Progress Report., July 15 - 20, 2003, Newport, Rhode Island

Report No.(s): DE2005-829849; No Copyright; Avail: Department of Energy Information Bridge

The Gordon Research Conference (GRC) on 2003 Organometallic Chemistry Gordon Conference was held at Salve Regina University, Newport, Rhode Island, July 20-25, 2003. The Conference was well-attended with 135 participants (attendees list attached). The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both U.S. and foreign scientists, senior researchers, young investigators, and students.

NTIS

Conferences; Organometallic Compounds

20050187082 Nuclear Services Corp., Essen, Germany

Dismantling of the Reactor Block of the FRJ-1 Research Reactor (Merlin)

Stahn, B.; Matela, K.; Zehbe, C.; Poeppinghaus, J.; Cremer, J.; Feb. 2003; 12 pp.; In English

Report No.(s): DE2005-827066; No Copyright; Avail: Department of Energy Information Bridge

This report describes the past procedure in dismantling the reactor block of the FRJ-1 research reactor (MERLIN). Furthermore, it gives an outlook on future activities up to the final removal of the reactor block. MERLIN is an abbreviation for Medium Energy Research Light Water Moderated Industrial Nuclear Reactor. The FRJ-1 (MERLIN) was shut down in 1985 and the fuel elements removed from the facility. After dismantling the coolant loops and removing the reactor tank internals with subsequent draining of the reactor tank water, the first activities for dismantling the reactor block were carried out in summer 2001. The relevant license was granted in late July 2001 by the licensing authority specifying 8 incidental provisions. After dismantling the reactor extension (gates of the thermal columns and steel platforms surrounding the reactor block), a heavy-load platform including a casing around the reactor block was constructed. Two ventilation systems with a volume flow of 10,000 and 2 ,000 m3/h will, moreover, serve to avoid a spread of contamination. The reactor block will be dismantled in three phases divided according to upper, central and bottom sections. Dismantling the upper section started in August 2002. This section as well as the bottom section can probably be completely measured for clearance. For this reason, the activities have so far been carried out manually using mechanical and thermal techniques.

NTIS

Radioactive Wastes; Waste Management; Reactor Cores

20050187092 Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA, Adelaide Univ., Australia

Towards a Connection Between Nuclear Structure and QCD

Thomas, A. W.; Guichon, P. A. M.; Leinweber, D. B.; January 2005; 18 pp.; In English

Report No.(s): DE2005-834967; No Copyright; Avail: Department of Energy Information Bridge

As we search for an ever deeper understanding of the structure of hadronic matter one of the most fundamental questions is whether or not one can make a connection to the underlying theory of the strong interaction, QCD. We build on recent advances in the chiral extrapolation problem linking lattice QCD at relatively large, light quark masses to the physical world to estimate the scalar polarizability of the nucleon. The latter plays a key role in modern relativistic mean-field descriptions of nuclei and nuclear matter (such as QMC) and, in particular, leads to a very natural saturation mechanism. We demonstrate that the value of the scalar polarizability extracted from the lattice data is consistent with that needed for a successful description of nuclei within the framework of QMC. In a very real sense this is the first hint of a direct connection between QCD and the properties of finite nuclei.

NTIS

Nuclear Structure; Quantum Chromodynamics; Chirality

20050187094 Maryland Univ., College Park, MD, USA

Advanced Computing for 21st Century Accelerator Science and Technology. Report for July 15, 2001-July 14, 2005

Dragt, A. J.; Sep. 2004; 8 pp.; In English

Report No.(s): DE2005-833400; No Copyright; Avail: Department of Energy Information Bridge

Dr. Dragt of the University of Maryland is one of the Institutional Principal Investigators for the SciDAC Accelerator Modeling Project Advanced Computing for 21st Century Accelerator Science and Technology whose principal investigators

are Dr. Kwok Ko (Stanford Linear Accelerator Center) and Dr. Robert Ryne (Lawrence Berkeley National Laboratory). This report covers the activities of Dr. Dragt while at Berkeley during spring 2002 and at Maryland during fall 2003.
NTIS
Linear Accelerators; Research and Development; Technologies

20050187096 Carnegie-Mellon Univ., Pittsburgh, PA USA
Long Time Behavior of Ferroelectric Systems
Greenberg, J. M.; MacCamy, R. C.; Coffman, C. V.; January 2005; 28 pp.; In English
Report No.(s): DE2005-821244; No Copyright; Avail: Department of Energy Information Bridge
In this note we investigate a new model for the behavior of ferroelectric materials. This model is analogous to one used to describe the dynamics of elastic materials which exhibit phase changes.
NTIS
Ferroelectric Materials; Ferroelectricity; Mathematical Models

20050187104 Pittsburgh Univ., Pittsburgh, PA, USA, Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA
Beyond the Constituent Quark Model
Swanson, E. S.; January 2005; 14 pp.; In English
Report No.(s): DE2005-804873; No Copyright; Avail: Department of Energy Information Bridge
A brief and biased overview of the status of the constituent quark model is presented. We concentrate on open issues and goals of hadronic phenomenology, rather than specific physics conundrums in the field. Modern attempts at addressing these issues are also presented.
NTIS
Quark Models; Elementary Particles

20050187105 Brookhaven National Lab., Upton, NY USA, City Univ. of New York, NY, USA, Yale Univ., New Haven, CT, USA
Micro and Mini-Bunching of the Slow External Beam at the AGS
Glenn, J. W.; Brennan, M.; Brown, K. A.; Majka, D.; Mincer, A.; Apr. 1999; 10 pp.; In English
Report No.(s): DE2005-770769; BNL-65974; No Copyright; Avail: Department of Energy Information Bridge
The AGS's prime function when RHIC comes on line will be as a heavy ion injector, free time will exist for unique operation that can be tailored and dedicated to users. Many of the next generation of experiments require RF time structure in the spill as it is extracted to time events or assure no background during decay times. Two methods have been developed to meet these needs. Micro-bunching where the beam is forced between empty buckets producing bursts at arbitrary integer harmonics of rotation period, and mini-bunching where the beam is kept bunched to provide high extinction between bursts. With an RF dipole the period may be increased to three times the rotation period of the beam. Further modeling and test results with beam will be presented. At high beam currents above transition, tight clusters of beam form causing severe random spike structure in the spill. Forcing the beam between empty buckets before extraction breaks up these clusters with minimal modulation of the spill at the RF frequency. Results of spill structure and loss reduction will be given.
NTIS
Beam Currents; Bunching

20050189202 Brookhaven National Lab., Upton, NY, USA
Workshop on the Physics Programme of the RBRC and UKQCD QCDOC Machines
January 2004; 150 pp.; In English
Report No.(s): DE2005-15011164; BNL-73604-2004; No Copyright; Avail: Department of Energy Information Bridge
The second intercollaborational workshop of RIKEN-BNL-Columbia (RBC) and UKQCD collaborations was organized as the RIKEN-BNL Research Center Workshop entitled Physics Programs of the RBRC and UKQCD QCDOC Computers and held at Brookhaven National Laboratory on November 12th and 13th, 2004. At the time of the meeting, two l2K-node QCDOC configurations, one in Edinburgh and the other at the RIKEN-BNL Research Center in Brookhaven were soon to become available for lattice QCD numerical calculations. Indeed the Edinburgh configuration had been successfully assembled and verified in Brookhaven during the preceding months, and was just shipped from Brookhaven and then received in Edinburgh. The RIKEN configuration was being assembled. As of this writing, the two configurations are now complete and ready to start

physics calculations. Since the first intercollaborational workshop held in Edinburgh in December, 2003, some members of the two collaborations had been discussing possible advantages of jointly producing gauge configurations with dynamical domain-wall fermion quark and improved gauge actions.
NTIS
Fermions; Domain Wall; Quantum Chromodynamics; High Energy Interactions; Quarks

20050189203 Brookhaven National Lab., Upton, NY, USA
FFAG-Based High-Intensity Proton Drivers
Ruggiero, A. G.; January 2004; 10 pp.; In English
Report No.(s): DE2005-15011152; BNL-73076-2004; No Copyright; Avail: Department of Energy Information Bridge
This paper is the summary of a feasibility study of a Fixed-Field Alternating-Gradient (FFAG) Accelerator for Protons in the one-to-few GeV energy range, and average beam power of several MWatt. The example they have adopted here is a beam energy of 1 GeV and an average power of 10 MWatt, but of course the same design approach can be used with other beam parameters. The design principles, merits and limitations of the FFAG accelerators have been described previously. In particular, more advanced techniques to minimize magnet dimension and field strength have been recently proposed. The design makes use of a novel concept by which it is possible to cancel chromatic effects, thus making betatron tunes and functions independent of the particle momentum, with an Adjusted Field Profile. The example given here assumes a pulsed mode of operation at the repetition rate of 1.0 kHz.
NTIS
Gradients; Protons

20050189207 Brookhaven National Lab., Upton, NY, USA
FFAG Accelerator as a New Injector for the BNL-AGS
Ruggiero, A. G.; January 2005; 14 pp.; In English
Report No.(s): DE2005-15011149; BNL-73582-2005; No Copyright; Avail: Department of Energy Information Bridge
It has been proposed recently to upgrade the Alternating-Gradient Synchrotron (AGS) of Brookhaven National Laboratory (BNL) to an average proton beam power of one MWatt at the top energy of 28 GeV. This is to be accomplished primarily by raising the AGS repetition rate from the present (approx.) 1/3 to 2.5 pulses per second, and by a relatively modest increase of beam intensity from the present 0.7 to about 1.0 x 10(sup 14) protons per cycle. The present injector, the 1.5 GeV Booster, has a circumference a quarter of that of the AGS, and four successive beam pulses are required for a complete fill of the AGS. The filling time at injection is thus at least 0.5 seconds, and it ought to be eliminated if one desires to shorten the AGS cycle period. Moreover, holding the beam for such a long period of time during injection causes its quality to deteriorate and beam losses. This report is the summary of the results of a feasibility study of a 1.5 GeV Fixed-Field Alternating-Gradient (FFAG) Accelerator as a new possible injection to the AGS.
NTIS
Injectors; Injection; Gradients

20050189210 Fermi National Accelerator Lab., Batavia, IL, USA
Beam-Beam Interactions
Chou, W.; Jan. 1998; 12 pp.; In English
Report No.(s): DE2005-16524; FERMILAB-CONF-98/029; No Copyright; Avail: Department of Energy Information Bridge
This paper gives a brief review of the beam-beam interactions of the hadron beams. Some recent results on the Pacman effect and dynamic aperture studies are also included.
NTIS
Beam Interactions; Hadrons

20050189211 Fermi National Accelerator Lab., Batavia, IL, USA
Some Issues on the RF System in the 3 GeV Fermilab Pre-Booster
Ng, K. Y.; Jun. 1998; 18 pp.; In English
Report No.(s): DE2005-16630; FERMILAB-CONF-98/168; No Copyright; Avail: Department of Energy Information Bridge
Some issues are presented on the rf system in the future Fermilab prebooster, which accelerates 4 bunches each containing 0.25 x 10(sub 14) protons from 1 to 3 GeV kinetic energy. The problem of beam loading is discussed. The proposal of having

a non-tunable fixed-frequency rf system is investigated. Robinson's criteria for phase stability are checked and possible Robinson instability growth is computed.
NTIS
Radio Frequencies; Kinetic Energy

20050189212 Fermi National Accelerator Lab., Batavia, IL, USA
Results on Dijets with a Central Rapidity Gap From CDF
Borras, K.; May 1998; 10 pp.; In English
Report No.(s): DE2005-16632; FERMILAB-CONF-98/150-E; No Copyright; Avail: Department of Energy Information Bridge

Results on dijets with a central rapidity gap at (radical)s = 1800 GeV are briefly summarized. Preliminary new results from data at (radical)s = 630 GeV are presented and compared to those at (radical)s = 1800 GeV.
NTIS
Quantum Chromodynamics; Inelastic Scattering

20050189213 Fermi National Accelerator Lab., Batavia, IL, USA
Probing Hard Color Singlet Exchange at D Zero
Goussiou, A.; Jun. 1998; 12 pp.; In English
Report No.(s): DE2005-16640; FERMILAB-CONF-98/171-E; No Copyright; Avail: Department of Energy Information Bridge

We present latest preliminary results on hard color-singlet exchange in proton-antiproton collisions. The fraction of dijet events produced via color-singlet exchange is measured as a function of jet transverse energy, dijet pseudorapidity separation, and proton-antiproton center-of-mass energy. The results favour a color-singlet fraction that increases with increasing quark-initiated processes.
NTIS
Color; Proton-Antiproton Interactions

20050189215 Fermi National Accelerator Lab., Batavia, IL, USA
Standardization of Beam Line Representations
Carey, D. C.; Jun. 1998; 20 pp.; In English
Report No.(s): DE2005-16686; FERMILAB-CONF-98-125; No Copyright; Avail: Department of Energy Information Bridge

Standardization of beam line representations means that a single set of data can be used in many situations to represent a beam line. This set of data should be the same no matter what the program to be run or the calculation to be made. We have concerned ourselves with three types of standardization: (1) The same set of dataerent programs. (2) The inclusion of other items in the data, such as calculations to be done, units to be used, or preliminary specications, should be in a notation similar to the lattice specication. (3) A single set of data should be used to represent a given beam line, no matter what is being modied or calculated. The specics of what is to be modied or calculated can be edited into the data as part of the calculation.
NTIS
Standardization; Data Bases; Data Structures

20050189223 Department of Energy, Washington, DC USA
4-th International Symposium on Ultrafast Surface Dynamics Telluride, Colorado (Telluride Summer Research Center) June 22-27, 2003
January 2003; 12 pp.; In English
Report No.(s): DE2005-836272; No Copyright; Avail: Department of Energy Information Bridge

The 4-th International Symposium on Ultrafast Surface Dynamics (UDS4) was held at the Telluride Summer Research Center on June 22-27, 2003. The International Organizing Committee consisting of Hrvoje Petek (USA), Xiaoyang Zhu (USA), Pedro Echenique (Spain) and Maki Kawai (Japan) brought together a total of 51 participants 16 of whom were from Europe, 10 from Japan, and 25 from the USA. The focus of the conference was on ultrafast electron or light induced processes at well-defined surfaces. Ultrafast surface dynamics concerns the transfer of charge and energy at solid surfaces on the femtosecond time scale. These processes govern rates of fundamental steps in surface reactions, interfacial electron transfer in molecular electronics, and relaxation in spin transport. Recent developments in femtosecond laser technology make it possible to measure by a variety of nonlinear optical techniques directly in the time domain the microscopic rates underlying

these interfacial processes. Parallel progress in scanning probe microscopy makes it possible at a single molecular level to perform the vibrational and electronic spectroscopy measurements, to induce reactions with tunneling electrons, and to observe their outcome. There is no doubt that successful development in the field of ultrafast surface dynamics will contribute to many important disciplines.
NTIS
Conferences; Electrons; Elementary Excitations; Molecular Dynamics; Phonons; Summer; Tellurides

20050189225 California Univ., Berkeley, CA, USA, Michigan Univ., Ann Arbor, MI, USA
Methods of Particle Detection for High-Energy Physics Experiments
Bradner, H.; Glaser, D. A.; Aug. 1958; 20 pp.; In English
Report No.(s): DE2005-4307793; No Copyright; Avail: Department of Energy Information Bridge
Particle detection instruments may be divided into two classes; devices which see the actual path of the particle, and counting devices which indicate the passage of a particle. Examples of each class are given, the characteristics of each example are tabulated, and the uses for each device are discussed.
NTIS
Detection; Elementary Particles; Radiation Detectors

20050189227 California Inst. of Tech., Pasadena, CA, USA, General Dynamics Corp., San Diego, CA, USA
Dispersion of the Neutron Emission in U235 Fission
January 2005; 22 pp.; In English
Report No.(s): DE2005-4354998; AECD-4223; No Copyright; Avail: Department of Energy Information Bridge
Equations are developed which allow the calculation of the average number of neutrons per U(sup 235) fission from experimental measurements. Experimental methods are described, the results of which give a value of (7.8(+-)0.6)(sup 1/2) neutrons per U(sup 235) thermal fission.
NTIS
Fission; Neutron Emission; Uranium 235

20050189240 Pisa Univ., Italy, Old Dominion Univ., Norfolk, VA, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA
Electromagnetic Transitions for A Equals 3 Nuclear Systems
Marcucci, L. E.; Viviani, M.; Schiavilla, R.; Kievsky, A.; Rosati, S.; Nov. 19, 2004; 14 pp.; In English
Report No.(s): DE2005-834965; No Copyright; Avail: Department of Energy Information Bridge
Recent advances in the study of pd radiative capture in a wide range of center-of-mass energy below and above deuteron breakup threshold are presented and discussed.
NTIS
Energy Levels; Deuterons

20050189254 Khlopin Radium Inst., Saint Petersburg, Russia, British Nuclear Fuels Ltd., Sellafield, UK
Composition of Insoluble Residues Generated During Spent Fuel Dissolution
Pokhitonov, Y.; Aleksandruk, V.; Bibichev, B.; Novikov, G.; January 2002; 12 pp.; In English
Report No.(s): DE2005-828959; No Copyright; Avail: Department of Energy Information Bridge
One type of HLW associated with the procedures of spent fuel reprocessing or conditioning as would be required in order to implement accelerator driven transmutation of waste, is the insoluble residue, which remains after the majority of the fuel, is dissolved. This material is separated as part of the head-end processing and must be suitably encapsulated within a waste-form to permit its disposal. In spite of the fact that the specific contribution of insoluble deposits, arising from SNF dissolution does not exceed 0,5-1 % of the general volume of wastes, the radionuclides, contained in them introduce a rather significant hazard and demand the most careful treatment of the material during its treatment and subsequent disposal. The main contributors to the insoluble residues are the slowly dissolving metallic fission product inclusions found in spent fuel and the certain fission products which although initially soluble precipitate during the dissolution process. The most significant elements, in mass terms are the platinum group metals (PGM) and, also molybdenum and zirconium. In turn, the formed deposits are capable of adsorbing fission products and actinides, for example, antimony, uranium and plutonium. This group of elements presents two issues one relating to the activity and heat of the relatively short-lived isotopes, in particular (sup 106)Ru/(sup 106)Rh and (sup 125)Sb and the other due to the presence of the long-lived and potentially environmentally

mobile (sup 99)Tc. The main factors determining the amount and composition of insoluble residues are the temperature and degree of burnup and conditions of fuel dissolution. In this paper the results on composition and mass determination of insoluble residues (primary and secondary), derived from samples of fuel with burnup from 15 up to 54 MWd/kgU are given. Dissolution of spent fuel samples was conducted at the boiling temperature and at 80 C. The concentration of nitric acid in the final solutions varied within the limits 1,7-3,5 mole/l and concentration of uranium from 250 to 350 g/l. The mass of insoluble residues obtained during experiments was from 0,03 to 0,5% (calculated for 1 kg of UO(sub 2) in spent fuel). Secondary residue examination has shown that their amounts were from 0,01 to 0,3% of fuel mass (from (approx) 5 to 50% of whole residue mass). The results of chemical analysis of primary and secondary residues and specific (beta)- and (alpha)-activities will be presented. The main elements, defining residue composition are as follows: metals of platinum group (palladium, ruthenium, rhodium), molybdenum and zirconium. The specific (beta)-activity of the residues was 20 to (approx) 840 Ci/kg and (alpha)-activity 0,01-8 Ci/kg. Depending on dissolution conditions uranium and plutonium contents in specimens analyzed were as much as 0,2-4% and 0,1-3% respectively. These results are compared with other literature data for residue arising and the significance of the insoluble residues in the context of long-term waste behavior will be discussed.
NTIS
Dissolving; Nuclear Fuels; Radioactive Materials; Residues; Solubility; Spent Fuels

20050189260 Brookhaven National Lab., Upton, NY, USA
Nuclear Data Review
Holden, N. E.; January 2004; 12 pp.; In English
Report No.(s): DE2005-15010745; BNL-73535-2004; No Copyright; Avail: Department of Energy Information Bridge
Non-neutron nuclear data are periodically reviewed and evaluated. The recommended values are published in the Table of the Isotopes of the Chemical Rubber Company's Handbook of Chemistry and Physics. A 2004 review has begun to re-examine some data of interest to the International Union of Geological Sciences (IUGS) sub-commission on Geochronology dealing with radioactive decay constants and isotopic abundance ratios. Among the decay constants that are being evaluated are those of the following nuclides: (sup 40)K, (sup 87)Rb, (sup 138)La, (sup 147)Sm, (sup 176)Lu, (sup 174)Hf, (sup 187)Re, (sup 190)Pt, (sup 232)Th, (sup 235)U, (sup 238)U.
NTIS
Chronology; Data Bases; Isotopes; Time Measurement

20050189263 Department of Energy, Washington, DC USA
2002 Gordon Research Conference on Atomic and Molecular Interactions. Final Progress Report
January 2004; 14 pp.; In English
Report No.(s): DE2005-823573; No Copyright; Avail: Department of Energy Information Bridge
The Gordon Research Conference (GRC) on Atomic & Molecular Interactions was held at Roger Williams University, Bristol, RI. Emphasis was placed on current unpublished research and discussion of the future target areas in this field.
NTIS
Atomic Interactions; Conferences; Molecular Interactions

20050189265 Brookhaven National Lab., Upton, NY USA
Hardware and Software Status of QCDOC
January 2005; 14 pp.; In English
Report No.(s): DE2005-15011209; BNL-73620-2005-CP; No Copyright; Avail: Department of Energy Information Bridge
QCDOC is a massively parallel supercomputer whose processing nodes are based on an application-specific integrated circuit (ASIC). This ASIC was custom-designed so that crucial lattice QCD kernels achieve an overall sustained performance of 50% on machines with several 10,000 nodes. This strong scalability, together with low power consumption and a price/performance ratio of $1 per sustained MFlops, enable QCDOC to attack the most demanding lattice QCD problems. The first ASICs became available in June of 2003, and the testing performed so far has shown all systems functioning according to specification. We review the hardware and software status of QCDOC and present performance figures obtained in real hardware as well as in simulation.
NTIS
Computer Programs; Computers; Integrated Circuits; Quantum Chromodynamics

20050189267 Brookhaven National Lab., Upton, NY USA

Prospects for Pentaquark Searchs in e+e- Annihilations and VV Collisions

Armstrong, S.; Mellado, B.; Wu, S. L.; January 2005; 20 pp.; In English

Report No.(s): DE2005-15011264; BNL-73675-20005-CP; No Copyright; Avail: Department of Energy Information Bridge

Recent strong experimental evidence of a narrow exotic S = +1 baryon resonance, (Theta)(sup +), suggests the existence of other exotic baryons. We discuss the prospects of confirming earlier experimental evidence of (Theta)(sup +) and the observation of additional hypothetical exotic baryons in e(sup +)e(sup -) annihilations and (gamma)(gamma) collisions at LEP and B Factories.

NTIS

Annihilation Reactions; Baryons; Collisions

20050189268 Department of Energy, Washington, DC USA

2002 Gordon Research Conference on Electron Donor Acceptor Interactions. Final Progress Report

January 2004; 14 pp.; In English

Report No.(s): DE2005-823982; No Copyright; Avail: Department of Energy Information Bridge

The Gordon Research Conference (GRC) on Electron Donor Acceptor Interactions was held at Salve Regina University, Newport, Rhode Island, August 11-16, 2002. The conference was well attended with 120 participants. The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both US and foreign scientists, senior researchers, young investigators, and students.

NTIS

Acceptor Materials; Conferences; Donor Materials; Electron Scattering; Electron Transfer

20050192030 Lawrence Livermore National Lab., Livermore, CA USA

Plutonium Ceramic Target for MASHA

Wilk, P. A.; Shaughnessy, D. A.; Moody, K. J.; Kenneally, J. M.; Jul. 12, 2004; 10 pp.; In English

Report No.(s): DE2005-15014426; UCRL-PROC-205183; No Copyright; Avail: Department of Energy Information Bridge

We are currently developing a plutonium ceramic target for the MASHA mass separator. The MASHA separator will use a thick plutonium ceramic target capable of tolerating temperatures up to 2000 degrees C. Promising candidates for the target include oxides and carbides, although more research into their thermodynamic properties will be required. Reaction products will diffuse out of the target into an ion source, where they will then be transported through the separator to a position-sensitive focal-plane detector array. Experiments on MASHA will allow us to make measurements that will cement our identification of element 114 and provide for future experiments where the chemical properties of the heaviest elements are studied.

NTIS

Ceramics; Plutonium; Targets

20050192031 Brookhaven National Lab., Upton, NY USA

Color Glass Condensate: A Summary of Key Ideas and Recent Developments

Venugopalan, R.; January 2005; 54 pp.; In English

Report No.(s): DE2005-15010766; BNL-73532-2005-CP; No Copyright; Avail: Department of Energy Information Bridge

We summarize the theory and phenomenology of the Color Glass Condensate reviewed previously by E. Iancu and the author in hep-ph/0303204. In addition, we discuss some of the subsequent developments in the past year both in theory and in phenomenological applications.

NTIS

Color; Condensates; Glass

20050192032 Brookhaven National Lab., Upton, NY, USA

RBRC Scientific Review Committee Meeting

January 2004; 614 pp.; In English

Report No.(s): DE2005-15010767; BNL-73546-2004; No Copyright; Avail: Department of Energy Information Bridge

The seventh evaluation of the RIKEN BNL Research Center (RBRC) took place on November 16 and 17, 2004, at Brookhaven National Laboratory. The present members of the Scientific Review Committee are Dr. Jean-Paul Blaizot, Professor Makoto Kobayashi, Dr. Akira Masaike, Professor Charles Young Prescott (Chair), Professor Stephen Sharpe (absent), and Professor Jack Sandweiss. We are grateful to Professor Claudio Rebbi who filled in for Professor Sharpe. In order

to illustrate the breadth and scope of the program, each member of the Center made a presentation on his research efforts. In addition, a special presentation was given jointly by our collaborators, Professors Norman Christ and Robert Mawhinney of Columbia University, on the progress and status of the RBRC QCDSP/QCDOC Supercomputer program.
NTIS
Supercomputers; Quantum Chromodynamics

20050192033 Brookhaven National Lab., Upton, NY, USA
RHIC Spin Collaboration Meetings, XXVII, XXVIII, XXX
January 2004; 252 pp.; In English
Report No.(s): DE2005-15011125; BNL-73506-2004; No Copyright; Avail: Department of Energy Information Bridge
The RIKEN BNL Research Center (RBRC) was established in April 1997 at Brookhaven National Laboratory. It is funded by the 'Rikagaku Kenkyusho' (RIKEN, The Institute of Physical and Chemical Research) of Japan. The Center is dedicated to the study of strong interactions, including spin physics, lattice QCD, and RHIC physics through the nurturing of a new generation of young physicists. This document describes the RHIC spin collaboration meetings XXVII, XXX on July 22, 2004.
NTIS
Quantum Chromodynamics; Spin

20050192034 Brookhaven National Lab., Upton, NY, USA
RHIC Spin Collaboration Meetings XXIX. Held at Torino, Italy on October 8-9, 2004
January 2004; 612 pp.; In English
Report No.(s): DE2005-15011126; BNL-73534-2004; No Copyright; Avail: Department of Energy Information Bridge
The RIKEN BNL Research Center (RBRC) was established in April 1997 at Brookhaven National Laboratory. It is funded by the 'Rikagaku Kenkyusho' (RIKEN, The Institute of Physical and Chemical Research) Japan. The Center is dedicated to the study of strong interactions, including spin physics, lattice QCD, and RHIC physics through the nurturing of a new generation of young physicists. This document describes the RHIC spin collaboration meeting XXIX on October 8-9, 2004 at Torino, Italy.
NTIS
Quantum Chromodynamics; Spin

20050192035 University of Southern Illinois, Carbondale, IL USA
Decoherence and the Performance of Geometric and Continuous-Time Quantum Computers: Model Building and Analysis
Gaitan, Frank; Jun. 2005; 11 pp.; In English
Contract(s)/Grant(s): DAAD-19-02-1-0051
Report No.(s): AD-A434749; ARO-43369.7-PH-QC; No Copyright; Avail: Defense Technical Information Center (DTIC)
Final report of funded work. Summarize problems studied; activities carried out; and results found. Describes the significance of these results for quantum computing and physics. Describes training and development of scientific personnel that have contributed to the activites associated with this grant.
DTIC
Quantum Computation; Quantum Computers

20050192036 Brookhaven National Lab., Upton, NY USA
Optimum Integral Design for Maximizing the Field in Short Magnets
Gupta, R.; January 2005; 10 pp.; In English
Report No.(s): DE2005-15011147; BNL-73576-20005; No Copyright; Avail: Department of Energy Information Bridge
An Optimum Integral Design is introduced for cosine(n(theta)) coils where the entire end-to-end length of the coil generates field with the dilution from ends practically eliminated. The benefits of such a design are particularly significant in short magnets where the overall coil length is comparable to or a few times the coil diameter. The integral field strength is further enhanced since the design allows a larger number of turns than in typical magnet coils. In this concept, the ends and body harmonics are optimized together to create an integral cosine(n(theta)) azimuthal current distribution. The concept was initially developed for wire/cable wound magnets where the bend radius of turns in the ends can be small. However, the benefit of this general approach can be applied to cable magnets as well. The magnetic design of a corrector dipole for the AGS helical

magnet, which was recently built and tested, is presented as one of several examples.
NTIS
Magnets; Current Distribution; Field Strength; Azimuth

20050192037 Brookhaven National Lab., Upton, NY, USA
Sharp Edge Effects of the Magnets of a FFAG Accelerator
Ruggiero, A. G.; January 2005; 8 pp.; In English
Report No.(s): DE2005-15011148; BNL-73581-2005; No Copyright; Avail: Department of Energy Information Bridge
The paper discusses the issues, the consequences and the methods for controlling the edge effects caused by particles entering and leaving magnets with trajectories at non-vanishing angles with the edges in FFAG accelerators made of Non-Scaling Lattices.
NTIS
Magnets; Trajectories

20050192045 North Carolina State Univ., Raleigh, NC USA
Research at and Operation of the Materials Science Beamline (X-11) at the National Synchrotron Light Source
Sayers, D. E.; January 2003; 20 pp.; In English
Contract(s)/Grant(s): DE-FG05-89ER-45384
Report No.(s): DE2005-821801; No Copyright; Avail: Department of Energy Information Bridge
This is the final report for DOE DE-FG02-89ER45384. An overview of the operational history and status of beamline X-11A at the end of the contract period, and a brief review of the core science program at NCSU and the scientific results of X-11A since the last progress report is also presented.
NTIS
Light Sources; Synchrotrons

20050192049 Fermi National Accelerator Lab., Batavia, IL, USA, State Research Center of Russia, Protvino, Russian Federation, Arizona Univ., Tucson, AZ, USA
Fast Scintillation Counters with WLS Bars
Bezzubov, V.; Denisov, D.; Denisov, S.; Diehl, H. T.; Dyshkant, A.; Jan. 1998; 14 pp.; In English
Report No.(s): DE2005-16518; FERMILAB-CONF-98/020; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
Scintillation Counters; Measuring Instruments

20050192051 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA USA
Tau Appearance in Atmospheric Neutrino Interactions
Hall, L. J.; Murayama, H.; Jul. 08, 2004; 18 pp.; In English
Report No.(s): DE2005-836541; LBNL-42429; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
Neutrinos; Oscillations; Particle Interactions

20050192055 Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA, Nagoya Univ., Nagoya, Japan, Syracuse Univ., NY, USA
Radiative Decays Involving a0(980) and f0(980) in Vector Meson Dominance Model
Black, D.; Harada, M.; Schechter, J.; January 2005; 12 pp.; In English
Report No.(s): DE2005-836925; No Copyright; Avail: Department of Energy Information Bridge
We summarize some features of the vector meson dominance model which was recently proposed for studying radiative decays involving the scalar mesons. Using the experimental values of (Gamma)(a(sub 0) (yields) (gamma)(gamma)), (Gamma)(f(sub 0) (yields) (gamma)(gamma)) and (Gamma)((phi) (yields) a(sub 0) (gamma)) as inputs, we show that the model predicts a large hierarchy between (Gamma)(a(sub 0) (yields) (omega)(gamma)) and (Gamma)(a(sub 0) (yields) (rho)(gamma)) as well as between (Gamma)(f(sub 0) (yields) (omega)(gamma)) and (Gamma)(f(sub 0) (yields) (rho)(gamma)).
NTIS
Mesons; Scalars; Vector Dominance Model; Vector Mesons; Radioactive Decay

20050192056 Department of Energy, Washington, DC USA
Multi Mega Watt Continuous Wave RF Window for Particle Accelerator Applications
January 2004; 22 pp.; In English
Report No.(s): DE2005-824080; No Copyright; Avail: Department of Energy Information Bridge

In the phase I project all tasks of the work plan have been completed. Stress analyses have been performed for three separate window geometries yielding overall stress distribution at the 10 Megawatt power level. The thin cylindrical shell having a characteristic impedance of 10 ohms with wave matching sections on either side demonstrated the lowest stress levels at full power. The maximum tensile stress in this geometry using TPA window material is 0.1E*8 Pa. Multipacting analysis was completed and no significant multipacting appeared at any power level up to 10 Mega Watts using a pessimistic SEY of 2.5 for the ceramic coating. A comparison of candidate materials with regard to all relevant electrical and thermal mechanical properties identified Translucent Polycrystalline Alumina (TPA) as a preferred choice. A complete set of engineering drawings along with a production plan was produced for the window assembly.

NTIS
Continuous Radiation; Particle Accelerators; Radio Frequencies

20050192059 Thomas Jefferson National Accelerator Facility, Newport News, VA, USA, Florida International Univ., Miami, FL, USA, American Phuscal Society, Ridge, NY, USA, Carnegie-Mellon Univ., Pittsburgh, PA, USA
Baryonic Operators for Lattice Simulations
Edwards, R.; Fiebig, R.; Fleming, G.; Heller, U. M.; Sep. 15, 2003; 8 pp.; In English
Report No.(s): DE2005-836868; No Copyright; Avail: Department of Energy Information Bridge

The construction of baryonic operators for determining the N* excitation spectrum is discussed. The operators are designed with one eye towards maximizing overlaps with the low-lying states of interest, and the other eye towards minimizing the number of sources needed in computing the required quark propagators. Issues related to spin identification are outlined. Although we focus on tri-quark baryon operators, the construction method is applicable to both mesons and penta-quark operators.

NTIS
Baryons; Simulation

20050192060 Los Alamos National Lab., NM USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA, Ohio State Univ., Columbus, OH, USA, Seoul National Univ., Korea, Republic of
Calculating Weak Matrix Elements using HYP Staggered Fermions
Bhattacharya, T.; Fleming, G. T.; Kilsup, G.; Gupta, R.; Lee, W.; January 2005; 8 pp.; In English
Report No.(s): DE2005-836869; No Copyright; Avail: Department of Energy Information Bridge

We present preliminary results of weak matrix elements relevant to CP violation calculated using the HYP (II) staggered fermions. Since the complete set of matching coefficients at the one-loop level became available recently, we have constructed lattice operators with all the g(sup 2) corrections included. The main results include both (Delta)I = 3/2 and (Delta)I = 1/2 contributions.

NTIS
Fermions; CP Violation

20050192281 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA, USA, European Organization for Nuclear Research, Geneva, Switzerland
Seiberg Duality and E(sup +)E(sup -) Experiments
De Gouvea, A.; Friedland, A.; Murayama, H.; Jul. 09, 2004; 28 pp.; In English
Report No.(s): DE2005-836538; LBNL-42246; No Copyright; Avail: Department of Energy Information Bridge

Seiberg duality in supersymmetric gauge theories is the claim that two different theories describe the same physics in the infrared limit. However, one cannot easily work out physical quantities in strongly coupled theories and hence it has been difficult to compare the physics of the electric and magnetic theories. In order to gain more insight into the equivalence of two theories, we study the 'e+e' cross sections into 'hadrons' for both theories in the superconformal window. We describe a technique which allows us to compute the cross sections exactly in the infrared limit. They are indeed equal in the low-energy limit and the equality is guaranteed because of the anomaly matching condition. The ultraviolet behavior of the total 'e+e' cross section is different for the two theories. We comment on proposed nonsupersymmetric dualities. We also analyze the

agreement of the ‘yy’ and ‘WW’ scattering amplitudes in both theories, and in particular try to understand if their equivalence can be explained by the anomaly matching condition.
NTIS
Gauge Theory; Supersymmetry; Scattering Amplitude

71
ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution*. For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion and Power*.

20050188486 NASA Lewis Research Center, Cleveland, OH, USA
A More Accurate and Efficient Technique Developed for Using Computational Methods to Obtain Helical Traveling-Wave Tube Interaction Impedance
Kory, Carol L.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The phenomenal growth of commercial communications has created a great demand for traveling-wave tube (TWT) amplifiers. Although the helix slow-wave circuit remains the mainstay of the TWT industry because of its exceptionally wide bandwidth, until recently it has been impossible to accurately analyze a helical TWT using its exact dimensions because of the complexity of its geometrical structure. For the first time, an accurate three-dimensional helical model was developed that allows accurate prediction of TWT cold-test characteristics including operating frequency, interaction impedance, and attenuation. This computational model, which was developed at the NASA Lewis Research Center, allows TWT designers to obtain a more accurate value of interaction impedance than is possible using experimental methods. Obtaining helical slow-wave circuit interaction impedance is an important part of the design process for a TWT because it is related to the gain and efficiency of the tube. This impedance cannot be measured directly; thus, conventional methods involve perturbing a helical circuit with a cylindrical dielectric rod placed on the central axis of the circuit and obtaining the difference in resonant frequency between the perturbed and unperturbed circuits. A mathematical relationship has been derived between this frequency difference and the interaction impedance (ref. 1). However, because of the complex configuration of the helical circuit, deriving this relationship involves several approximations. In addition, this experimental procedure is time-consuming and expensive, but until recently it was widely accepted as the most accurate means of determining interaction impedance. The advent of an accurate three-dimensional helical circuit model (ref. 2) made it possible for Lewis researchers to fully investigate standard approximations made in deriving the relationship between measured perturbation data and interaction impedance. The most prominent approximations made in the analysis were addressed and fully investigated for their accuracy by using the three-dimensional electromagnetic simulation code MAFIA (Solution of Maxwell’s Equations by the Finite Integration Algorithm) (refs. 3 and 4). We found that several approximations introduced significant error (ref. 5).
Derived from text
Wave Propagation; Impedance; Traveling Wave Amplifiers

20050188501 NASA Lewis Research Center, Cleveland, OH, USA
Technique Developed for Optimizing Traveling-Wave Tubes
Wilson, Jeffrey D.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A traveling-wave tube (TWT) is an electron beam device that is used to amplify electromagnetic communication waves at radio and microwave frequencies. TWT s are critical components in deep-space probes, geosynchronous communication satellites, and high-power radar systems. Power efficiency is of paramount importance for TWT s employed in deep-space probes and communications satellites. Consequently, increasing the power efficiency of TWT s has been the primary goal of the TWT group at the NASA Lewis Research Center over the last 25 years. An in-house effort produced a technique (ref. 1) to design TWT’s for optimized power efficiency. This technique is based on simulated annealing, which has an advantage over conventional optimization techniques in that it enables the best possible solution to be obtained (ref. 2). A simulated annealing algorithm was created and integrated into the NASA TWT computer model (ref. 3). The new technique almost doubled the computed conversion power efficiency of a TWT from 7.1 to 13.5 percent (ref. 1).
Derived from text
Traveling Wave Tubes; Microwave Frequencies; Radio Frequencies; Algorithms

20050192082 NASA Langley Research Center, Hampton, VA, USA

The Derivation of the Gradient of the Acoustic Pressure on a Moving Surface for Application to the Fast Scattering Code (FSC)

Farassat, F.; Brentner, Kenneth S.; July 2005; 11 pp.; In English

Contract(s)/Grant(s): 23-781-10-33

Report No.(s): NASA/TM-2005-213777; L-19138; No Copyright; Avail: CASI; A03, Hardcopy

In this paper we develop an analytic expression for calculation of the the acoustic pressure from a rotating blade on a moving surface for application to the Fast Scattering Code (FSC). The analytic result is intended to be used in the helicopter noise prediction code PSU-WOPWOP. One of the goals of the derivation is obtaining a result that will not use any more information than are needed for the prediction of the thickness and loading noise. The result derived here achieves this goal and its incorporation in PSU-WOPWOP is straight forward and attainable.

Author

Noise Prediction; Analysis (Mathematics); Scattering; Aircraft Noise; Sound Pressure

20050192383 NASA Glenn Research Center, Cleveland, OH, USA, Modern Technologies Corp., OH, USA

Screech Noise Generation From Supersonic Underexpanded Jets Investigated

Panda, Jayanta; Seasholtz, Richard G.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Many supersonic military aircraft and some of the modern civilian aircraft (such as the Boeing 777) produce shock-associated noise. This noise is generated from the jet engine plume when the engine nozzle is operated beyond the subsonic operation limit to gain additional thrust. At these underexpanded conditions, a series of shock waves appear in the plume. The turbulent vortices present in the jet interact with the shock waves and produce the additional shock-associated noise. Screech belongs to this noise category, where sound is generated in single or multiple pure tones. The high dynamic load associated with screech can damage the tailplane. One purpose of this study at the NASA Glenn Research Center at Lewis Field was to provide an accurate data base for validating various computational fluid dynamics (CFD) codes. These codes will be used to predict the frequency and amplitude of screech tones. A second purpose was to advance the fundamental physical understanding of how shock-turbulence interactions generate sound. Previously, experiments on shock-turbulence interaction were impossible to perform because no suitable technique was available. As one part of this program, an optical Rayleigh-scattering measurement technique was devised to overcome this difficulty.

Author

Screech Tones; Aerodynamic Noise; Noise Generators; Plumes; Shock Waves; Supersonic Jet Flow; Turbulence

20050192402 NASA Glenn Research Center, Cleveland, OH, USA, Nevada Univ., NV, USA

Passive Acoustic Tomography Tested for Measuring Gas Temperatures

Fralick, Gustave C.; Kleppe, John; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The requirements of higher performance, better fuel economy, and lower emissions place an increasing premium on knowing the internal operating parameters of jet engines. One of the most important is the gas temperature in the post combustor section of the engine. Typically the gas temperature is measured with a thermocouple probe or by some optical technique such as Rayleigh scattering. Probes, while providing valuable information, have several limitations. The probe signal must be corrected for radiation and conduction losses, probes provide only a point measurement, and probes must be constructed of materials whose melting points are lower than the temperature of the environment into which they are inserted. Some of the disadvantages of probes are overcome by various optical techniques. Nothing needs to be inserted into the flow, and the temperature can be directly related to the signal by known physical laws. However, optical techniques require optical access (i.e., a window) and a light source (such as a laser), and they are very sensitive to the presence of particles in the flow. To overcome these problems, researchers from the NASA Glenn Research Center and The University of Nevada are developing a technique that uses sound instead of light to measure gas temperature. Like optical techniques, it is nonintrusive--no probe need be exposed to the combustion environment--and the temperature is directly related to a measured quantity--the speed of sound, which is proportional to the square root of the absolute temperature. The temperature profile inside the engine is constructed from the differences in arrival time between correlated signals from an array of microphones placed around the circumference of the engine. In much the same way as a complete picture of the inside of your body can be constructed from an array of x-ray photographs taken at different angles, the temperature profile in the engine is constructed from the angular array of microphones. It is tomography by sound waves. Active acoustic tomography, in which a sound pulse is injected into the flow and the time delays between members of an array of microphones are used to construct the temperature

field has been used successfully in the stacks of power plants. However, the flow field inside a jet engine is much too noisy for it to be possible to detect an externally injected sound pulse. Instead we are developing passive acoustic tomography, which uses the sound already present in the flow.
Author
Gas Temperature; Acoustic Velocity; Tomography; Flow Distribution; Light Sources; Temperature Distribution

20050192421 NASA Langley Research Center, Hampton, VA, USA, Raytheon Technical Services Co., Hampton, VA, USA
A Survey of Singular Value Decomposition Methods and Performance Comparison of Some Available Serial Codes
Plassman, Gerald E.; July 2005; 27 pp.; In English
Contract(s)/Grant(s): GSA-GS-00T-99-ALD-0209; 23-781-10-11
Report No.(s): NASA/CR-2005-213500; No Copyright; Avail: CASI; A03, Hardcopy

This contractor report describes a performance comparison of available alternative complete Singular Value Decomposition (SVD) methods and implementations which are suitable for incorporation into point spread function deconvolution algorithms. The report also presents a survey of alternative algorithms, including partial SVD's special case SVD's, and others developed for concurrent processing systems.
Author
Numerical Analysis; Applications of Mathematics; Data Processing; Singularity (Mathematics)

72
ATOMIC AND MOLECULAR PHYSICS

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

20050186922 National Inst. of Information and Communications Technology, Japan
Trapping and Cooling of Ions for Quantum Information Processing
Hayasaka, Kazuhiro; Imajo, Hidetsuka; Uetake, Satoshi; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 59-68; In English; See also 20050186915; Copyright; Avail: Other Sources

In quantum networks quantum information is processed by exchanging quantum states between physical systems. We have studied trapping and cooling of ions for quantum information processing to build a prototype of the quantum network. We have found (43)Ca(+) as the best candidate for the qubit in the quantum network. The schemes for quantum gate operations and for quantum state transfer with the ion species are discussed. We have developed a ring ion trap and a light source consisting of violet diode lasers for realizing the schemes. We have achieved deterministic coupling of a single (40)Ca(+) to the optical field in a cavity.
Author
Ions; Trapping; Ion Storage; Quantum Communication; Data Processing; Cooling

20050188500 NASA Lewis Research Center, Cleveland, OH, USA
Atomic Oxygen Lamp Cleaning Facility Fabricated and Tested
Sechkar, Edward A.; Stueber, Thomas J.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Lewis Research Center's Atomic Oxygen Lamp Cleaning Facility was designed to produce an atomic oxygen plasma within a metal halide lamp to remove carbon-based contamination. It is believed that these contaminants contribute to the high failure rate realized during the production of these lamps. The facility is designed to evacuate a metal halide lamp and produce a radio frequency generated atomic oxygen plasma within it. Oxygen gas, with a purity of 0.9999 percent and in the pressure range of 150 to 250 mtorr, is used in the lamp for plasma generation while the lamp is being cleaned. After cleaning is complete, the lamp can be backfilled with 0.9999-percent pure nitrogen and torch sealed. The facility comprises various vacuum components connected to a radiation-shielded box that encloses the bulb during operation. Radiofrequency power is applied to the two parallel plates of a capacitor, which are on either side of the lamp. The vacuum pump used, a Leybold Trivac Type D4B, has a pumping speed of 4-m3/hr, has an ultimate pressure of \h8x10-4, and is specially adapted for pure oxygen service. The electronic power supply, matching network, and controller (500-W, 13.56-MHz) used to supply

the radiofrequency power were purchased from RF Power Products Inc. Initial test results revealed that this facility could remove the carbon-based contamination from within bulbs.
Author
Luminaires; Cleaning; Oxygen Atoms; Oxygen Plasma

73
NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

20050192308 Oregon Graduate Inst. of Science and Technology, Beaverton, OR, USA
Evaluation of the Stochastic Effects of Low-Dose Radiation: Dose Reconstruction for the Techa River Cohort in Russia
Degteva, M. O.; Kozheurov, V. P.; Tolstyh, E. I.; Vorobiova, M. I.; January 2005; 6 pp.; In English
Report No.(s): DE2005-15004488; No Copyright; Avail: Department of Energy Information Bridge

Persons traveling in space can accumulate fairly large doses of radiation, up to several Sv, at low-to-moderate dose rates. In general these dose rates are low enough so that deterministic effects can be avoided, although shielding may be necessary. An important question, however, is the stochastic effects (induction of cancer and genetic defects) of these doses. Most radiation-risk estimates are based on dose reconstruction and epidemiologic follow-up of the survivors of the atomic bombings on Japan, events that delivered doses nearly instantaneously. It has been hoped that stochastic effects would be less probable for radiation delivered at lower dose rates, but few opportunities have been available to examine this question in humans. The Mayak Production Association (MPA) was the first Russian site for the production and separation of plutonium. This plant began operation in 1948, and during its early days there were high occupational doses as well as technological failures that resulted in the release of large amounts of waste (about 10 (up arrow) 17 Bq of liquid wastes) into the rather small Techa River. Residents along the Techa River were exposed to external radiation, and they ingested foods contaminated with 90Sr and other radionuclides. The Techa River Cohort has been studied for several years by scientists from the Urals Research Center for Radiation Medicine (URCRM). The purpose of the project considered here is to improve the dose-reconstruction system for the Techa River Cohort that has been under development for many years by Russian scientists at the URCRM. This, and the companion epidemiologic studies, are deemed to be unique and important, as members of the Techa River Cohort received red bone marrow doses of up to 3 Gy, but at low-to-moderate-dose rates. An increase in leukemia and cancer mortality has already been noted for this population, and further study should allow the evaluation of dose-rate-reduction factors for this situation.
NTIS
Radiation Dosage; Rivers; Russian Federation; Stochastic Processes; Strontium 90; Radiation Hazards; Water Pollution; Cancer; Public Health; Nuclear Medicine

74
OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

20050186923 National Inst. of Information and Communications Technology, Japan
Generation and Application of Quantum-Correlated Twin Beams
Kasai, Katsuyuki; Sasaki, Masahide; Zhang, Yun; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 69-78; In English; See also 20050186915; Copyright; Avail: Other Sources

The signal and idler beams from a non-degenerate, above threshold, optical parametric oscillator have a strong quantum correlation, which are called twin beams. This correlation arises from the simultaneous generation of the signal and idler photons in the form of twin pairs of photons through the parametric down conversion, and the generated twin beams have exactly the same photon statistics. As a result, the fluctuations on the difference between the intensities of the twin beams are reduced with respect to the shot-noise limit, that is, intensity-difference squeezing. We have observed squeezing of 8 dB (84%) on the intensity difference between the twin beams generated by a semimonolithic optical parametric oscillator. In this paper,

a comprehensive overview of the generation of twin beams using the optical parametric oscillator and the applications exploiting the quantum correlation of twin beams are presented.
Author
Optical Communication; Quantum Communication; Light Beams; Squeezed States (Quantum Theory)

20050186929 National Inst. of Information and Communications Technology, Japan
Optical Thin Film Technology Used in the Terahertz Frequency
Hosako, Iwao; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 87-94; In English; See also 20050186915; Copyright; Avail: Other Sources

The multi-layer optical films realize various functions such as wide-band anti-reflection coating, high reflection coating, low-pass filter, high-pass filter, band-pass filter, polarizing beam splitter, and non-polarizing beam splitter, etc. Although the multi-layer optical coatings are commonly used in light-wave regions (visible, near-infrared, and mid-infrared regions), it has not yet fully realized in the terahertz electromagnetic wave region (customarily defined as f = 0.3 - 10 THz, lambda = 1000 - 30 microns). Single-layer coatings used at terahertz frequencies have realized by some methods, however, there has been almost no report on the fabrication method for the multi-layer coatings. Because each layer in the multi-layer structure must be as thick as several to several tens of micrometers, which is far thicker than coating used in optical regions. A method for manufacturing multi-layer optical coatings for optics used at terahertz frequencies has therefore been developed. The method forms a multi-layer structure, consisting of silicon and silicon-oxide layers, through plasma-enhanced chemical vapor deposition (CVD) using silane (SiH4) and oxygen (O2) as source gases. This method has lots of advantages over other methods. The details of the method and also the optical properties of a single layer anti-reflection coating and a four-layer wideband anti-reflection coating on a germanium substrate are reported.
Author
Thin Films; Optical Coatings; Vapor Deposition; Silanes

20050186931 National Inst. of Information and Communications Technology, Japan
Nondiffracting Light Beams for Long Ranges
Aruga, Tadashi; Kunimori, Hiroo; Journal of the National Institute of Information and Communications Technology. Special Issue on Optical COE (Center of Excellence), Volume 51, Nos. 1/2; March/June 2004, pp. 113-118; In English; See also 20050186915; Copyright; Avail: Other Sources

A method of generating an unusual light beam, long range nondiffracting beam (LRNB) has been studied. The LRNB propagates over a long range keeping its narrow beam width as if it does not diffract, while general light beams spread by the diffraction effect. The new beam can be generated by a technique of wave front control, e.g., by a distorted concave spherical wave front that can be formed by a Galilean transmitting telescope with an eyepiece that has a spherical aberration. We will introduce some results of experiments as well as theoretical analyses of the LRNB generation using an unique optical system with a telescope and a laser.
Author
Light Beams; Wave Diffraction; Refracting Telescopes; Light Transmission; Optical Correction Procedure

20050187081 California Univ., Los Angeles, CA, USA
Continuation of Full-Scale Three-Dimensional Numerical Experiments on High-Intensity Particle and Laser Beam-Matter Interactions
Mori, W. B.; Sep. 2003; 12 pp.; In English
Report No.(s): DE2005-825203; No Copyright; Avail: Department of Energy Information Bridge

To continue and extend our ‘Full-scale three-dimensional numerical experiments on high-intensity particle and laser beam-matter interactions’.
NTIS
Beam Interactions; Laser Beams; Particle Beams

20050188450 NASA Lewis Research Center, Cleveland, OH, USA
Changes in the Optical Properties of Materials Are Observed After 18 Months in Low Earth Orbit
Jaworske, Donald A.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Materials located on the exterior of spacecraft in low Earth orbit are subjected to a number of environmental threats, including atomic oxygen, ultraviolet radiation, thermal cycling, and micrometeroid and debris impact. Atomic oxygen attacks materials vulnerable to oxidation. Ultraviolet radiation can break chemical bonds and cause undesirable changes in optical properties. Thermal cycling can cause cracking, and micrometeroid and debris impacts can damage protective coatings. Another threat is contamination. The outgassing of volatile chemicals can contaminate nearby surfaces, changing their thermal control properties. Contaminated surfaces may undergo further change as a result of atomic oxygen and ultraviolet radiation exposure. The Passive Optical Sample Assembly (POSA) experiment was designed as a risk mitigation experiment for the International Space Station. Samples were characterized before launch, exposed for 18 months on the exterior of Mir, and characterized upon their return. Lessons learned from POSA about the durability of material properties can be applied to the space station and other long-duration missions.
Derived from text
Optical Properties; Spaceborne Experiments; Long Term Effects; Earth Orbital Environments

20050188529 NASA Lewis Research Center, Cleveland, OH, USA
Dual-Laser Probe for Measuring Blade-Tip Clearance Tested
Dhadwal, Harbans S.; Kurkov, Anatole P.; Research and Technology 1998; April 1999; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A dual-probe, integrated fiber-optic laser system for measuring blade tip clearance in rotating turbomachinery was developed cooperatively with Integrated Fiber Optic Systems, Inc., and tested at the NASA Lewis Research Center. Because the probes are nearly flush with the casing inner lining, there is minimal flow disturbance. The two probes are closely spaced in a circumferential plane and are slanted at an angle relative to each other so that the time it takes the blade tip to traverse the space between the two beams varies with the tip radius, making it possible to determine the tip clearance at rotor operating conditions. The tip clearance can be obtained for all the blades in a rotor with a single system, provided there are no synchronous vibrations present at a particular operating condition. The two probes for the laser system were installed in two holders. For one, the included angle between the probes was 20 degrees, and for the other, it was 40 degrees. The two configurations were calibrated in a vacuum spin-rig facility that can reproduce realistic blade-tip speeds. A specially designed, nondeflecting rotor was used to calibrate the probes. This rotor consisted of a tapered titanium bar with three teeth on each end, the thickness of which was representative of a typical blade-tip thickness. The bar and measuring teeth were in a horizontal plane in the spin rig, and the axis of rotation was vertical. To set the clearances, we used a remotely controlled optical stage that could be traversed vertically. The 40 probe system also was used to measure the tip clearance during an engine fan prototype test in a wind tunnel. Using the spin-rig calibrations, we estimated the accuracy of the tip-clearance measurement in the test to be 0.005 in. This program is ongoing.
Author
Blade Tips; Fiber Optics; Lasers; Turbomachinery; Wind Tunnel Tests; Probes

20050189217 Lawrence Livermore National Lab., Livermore, CA USA
Modeling Characterization of the National Ignition Facility Focal Spot
Williams, W. H.; Auerbach, J. M.; Henesian, M. A.; Lawson, J. K.; Hunt, J. T.; Jan. 16, 1998; 18 pp.; In English
Report No.(s): DE2005-16715; UCRL-JC-127907; No Copyright; Avail: Department of Energy Information Bridge

The predicted focal spot size of the National Ignition Facility laser is parameterized against the finish quality of the optics in the system. Results are reported from simulations which include static optics aberrations, as well as pump-induced distortions, beam self-focusing, and the effect of an adaptive optic. The simulations do not include contributions from optics mounting errors, residual thermal noise in laser slabs from previous shots, air turbulence, a kinoform phase plate, or smoothing by spectral dispersion (SSD). Consequently, these results represent ‘first shot of the day’, without-SSD, predictions.
NTIS
Ignition; Simulation

20050192188 NASA Glenn Research Center, Cleveland, OH, USA
Stretched Lens Array Photovoltaic Concentrator Technology Developed
Piszczor, Michael F., Jr.; O’Neill, Mark J.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Solar arrays have been and continue to be the mainstay in providing power to nearly all commercial and government spacecraft. Light from the Sun is directly converted into electrical energy using solar cells. One way to reduce the cost of

future space power systems is by minimizing the size and number of expensive solar cells by focusing the sunlight onto smaller cells using concentrator optics. The stretched lens array (SLA) is a unique concept that uses arched Fresnel lens concentrators to focus sunlight onto a line of high-efficiency solar cells located directly beneath. The SLA concept is based on the Solar Concentrator Array with Refractive Linear Element Technology (SCARLET) design that was used on NASA's New Millennium Deep Space 1 mission. The highly successful asteroid/comet rendezvous mission (1998 to 2001) demonstrated the performance and long-term durability of the SCARLET/SLA solar array design and set the foundation for further improvements to optimize its performance.
Author
Spacecraft Power Supplies; Concentrators; Solar Collectors

20050192263 NASA Glenn Research Center, Cleveland, OH, USA
Scanning Tunneling Optical Resonance Microscopy Developed
Bailey, Sheila G.; Raffaelle, Ryne P.; Lau, Janis E.; Jenkins, Phillip P.; Castro, Stephanie L.; Tin, Padetha; Wilt, David M.; Pal, Anna Maria; Fahey, Stephen D.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The ability to determine the in situ optoelectronic properties of semiconductor materials has become especially important as the size of device architectures has decreased and the development of complex microsystems has increased. Scanning Tunneling Optical Resonance Microscopy, or STORM, can interrogate the optical bandgap as a function of its position within a semiconductor micro-structure. This technique uses a tunable solidstate titanium-sapphire laser whose output is 'chopped' using a spatial light modulator and is coupled by a fiber-optic connector to a scanning tunneling microscope in order to illuminate the tip-sample junction. The photoenhanced portion of the tunneling current is spectroscopically measured using a lock-in technique. The capabilities of this technique were verified using semiconductor microstructure calibration standards that were grown by organometallic vapor-phase epitaxy. Bandgaps characterized by STORM measurements were found to be in good agreement with the bulk values determined by transmission spectroscopy and photoluminescence and with the theoretical values that were based on x-ray diffraction results.
Derived from text
Scanning Tunneling Microscopy; Optical Resonance

20050192343 NASA Glenn Research Center, Cleveland, OH, USA
Facility Designed and Built to Investigate the Combined Effects of Contaminant and Atomic Oxygen on a Light-Transmitting Surface
Sechkar, Edward A.; Stueber, Thomas J.; Tutledge, Sharon K.; Banks, Bruce A.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A need exists to investigate changes in the transparency of a light-transmitting surface during simultaneous exposure to a contaminant and an atomic oxygen (AO) flux. This mechanism may be responsible for the degradation of the light-transmitting surfaces of both photovoltaic cells and photodiodes currently in use on many low-Earth-orbit spacecraft. To address this need, researchers from the Electro-Physics Branch of the NASA Glenn Research Center at Lewis Field built such a test system within their AO beam facility. This facility produces an effective AO flux of 1.4 10(exp 16) atoms/sq cm/sec and contains a three-axis positioning system that provides the motion capability necessary for test operations. During testing, a target surface is held directly within the AO beam and close to two contaminant effusion cells. The effusion cells are shielded from the AO beam, and the outgassing contaminant is constrained to move across the target surface when heat is applied to either of the reservoirs. A light source is periodically moved over the target surface, and the transmitted light intensity is checked with a photodiode located below the target. This light source is also periodically checked with a separate photodiode, which is protected from contamination and AO exposure, to allow adjustments necessary to maintain a consistent light intensity.
Author
Contaminants; Light Sources; Oxygen Atoms; Luminous Intensity; Photovoltaic Cells

20050192350 NASA Glenn Research Center, Cleveland, OH, USA
Portable Infrared Reflectometer Designed and Manufactured for Evaluating Emittance in the Laboratory or in the Field
Jaworske, Donald A.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The optical properties of materials play a key role in spacecraft thermal control. In space, radiant heat transfer is the only mode of heat transfer that can reject heat from a spacecraft. One of the key properties for defining radiant heat transfer is emittance, a measure of how efficiently a surface can reject heat in comparison to a perfect black body emitter. Heat rejection occurs in the infrared region of the spectrum, nominally in the range of 2 to 25 mm. To calculate emittance, one obtains the reflectance over this spectral range, calculates spectral absorptance by difference, and then uses Kirchhoff s Law and the Stefan-Boltzmann equation to calculate emittance. A new portable infrared reflectometer, the SOC 400t, was designed and manufactured to evaluate the emittance of surfaces and coatings in the laboratory or in the field. It was developed by Surface Optics Corporation under a contract with the NASA Glenn Research Center at Lewis Field to replace the Center s aging Gier-Dunkle DB-100 infrared reflectometer. The specifications for the new instrument include a wavelength range of 2 to 25 mm; reflectance repeatability of +/-1 percent; self-calibrating, near-normal spectral reflectance measurements; a full scan measurement time of 3.5 min, a sample size of 1.27 cm (0.5 in.); a spectral resolution selectable from 4, 8, 16, or 32/cm; and optical property characterization utilizing an automatic integration to calculate total emittance in a selectable temperature range.

Author

Emittance; Reflectometers; Optical Properties; Temperature Control; Radiative Heat Transfer; Infrared Radiation; Calibrating

20050192363 NASA Glenn Research Center, Cleveland, OH, USA

Three-Dimensional Electron Optics Model Developed for Traveling-Wave Tubes

Kory, Carol L.; Research and Technology 1999; March 2000; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A three-dimensional traveling-wave tube (TWT) electron beam optics model including periodic permanent magnet (PPM) focusing has been developed at the NASA Glenn Research Center at Lewis Field. This accurate model allows a TWT designer to develop a focusing structure while reducing the expensive and time-consuming task of building the TWT and hot-testing it (with the electron beam). In addition, the model allows, for the first time, an investigation of the effect on TWT operation of the important azimuthally asymmetric features of the focusing stack. The TWT is a vacuum device that amplifies signals by transferring energy from an electron beam to a radiofrequency (RF) signal. A critically important component is the focusing structure, which keeps the electron beam from diverging and intercepting the RF slow wave circuit. Such an interception can result in excessive circuit heating and decreased efficiency, whereas excessive growth in the beam diameter can lead to backward wave oscillations and premature saturation, indicating a serious reduction in tube performance. The most commonly used focusing structure is the PPM stack, which consists of a sequence of cylindrical iron pole pieces and opposite-polarity magnets. Typically, two-dimensional electron optics codes are used in the design of magnetic focusing devices. In general, these codes track the beam from the gun downstream by solving equations of motion for the electron beam in static-electric and magnetic fields in an azimuthally symmetric structure. Because these two-dimensional codes cannot adequately simulate a number of important effects, the simulation code MAFIA (solution of Maxwell's equations by the Finite-Integration-Algorithm) was used at Glenn to develop a three-dimensional electron optics model. First, a PPM stack was modeled in three dimensions. Then, the fields obtained using the magnetostatic solver were loaded into a particle-in-cell solver where the fully three-dimensional behavior of the beam was simulated in the magnetic focusing field. For the first time, the effects of azimuthally asymmetric designs and critical azimuthally asymmetric characteristics of the focusing stack (such as shunts, C-magnets, or magnet misalignment) on electron beam behavior have been investigated. A cutaway portion of a simulated electron beam focused by a PPM stack is illustrated.

Author

Electron Optics; Three Dimensional Models; Traveling Wave Tubes

20050192409 NASA Glenn Research Center, Cleveland, OH, USA

Reannealed Fiber Bragg Gratings Demonstrated High Repeatability in Temperature Measurements

Adamovsky, Grigory; Juergens, Jeffrey R.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Fiber Bragg gratings (FBGs) are formed by periodic variations of the refractive index of an optical fiber. These periodic variations allow an FBG to act as an embedded optical filter, passing the majority of light propagating through a fiber while reflecting back a narrow band of the incident light. The peak reflected wavelength of the FBG is known as the Bragg wavelength. Since the period and width of the refractive index variation in the fiber determines the wavelengths that are transmitted and reflected by the grating, any force acting on the fiber that alters the physical structure of the grating will change the wavelengths that are transmitted and reflected by it. Both thermal and mechanical forces acting on the grating will alter its physical characteristics, allowing the FBG sensor to detect both the temperature variations and the physical stresses and

strains placed upon it. This ability to sense multiple physical forces makes the FBG a versatile sensor. To assess the feasibility of using Bragg gratings as temperature sensors for propulsion applications, researchers at the NASA Glenn Research Center evaluated the performance of Bragg gratings at elevated temperatures for up to 300 C. For these purposes, commercially available polyimide-coated high-temperature gratings were used that were annealed by the manufacturer to 300 C. To assure the most thermally stable gratings at the operating temperatures, we reannealed the gratings to 400 C at a very slow rate for 12 to 24 hr until their reflected optical powers were stabilized. The reannealed gratings were then subjected to periodic thermal cycling from room temperature to 300 C, and their peak reflected wavelengths were monitored. The setup shown is used for reannealing and thermal cycling the FBGs. Signals from the photodetectors and the spectrum analyzer were fed into a computer equipped with LabVIEW software. The software synchronously monitored the oven/furnace temperature and the optical spectrum analyzer as well as processed the data. Experimental results presented in the following graph show typical wavelength versus temperature dependence of a reannealed FBG through six thermal cycles (80 hr). The average standard deviation of the temperature-to-wavelength relationship ranged from 1.86 to 2.92 C over the six thermal cycles each grating was subjected to. This is an error of less than 1.0 percent of full scale throughout the entire evaluation temperature range from ambient to 300 C.

Author

Annealing; Bragg Gratings; Temperature Measurement; Optical Fibers

20050192412 NASA Glenn Research Center, Cleveland, OH, USA

Optical Calibration Process Developed for Neural-Network-Based Optical Nondestructive Evaluation Method

Decker, Arthur J.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A completely optical calibration process has been developed at Glenn for calibrating a neural-network-based nondestructive evaluation (NDE) method. The NDE method itself detects very small changes in the characteristic patterns or vibration mode shapes of vibrating structures as discussed in many references. The mode shapes or characteristic patterns are recorded using television or electronic holography and change when a structure experiences, for example, cracking, debonds, or variations in fastener properties. An artificial neural network can be trained to be very sensitive to changes in the mode shapes, but quantifying or calibrating that sensitivity in a consistent, meaningful, and deliverable manner has been challenging. The standard calibration approach has been difficult to implement, where the response to damage of the trained neural network is compared with the responses of vibration-measurement sensors. In particular, the vibration-measurement sensors are intrusive, insufficiently sensitive, and not numerous enough. In response to these difficulties, a completely optical alternative to the standard calibration approach was proposed and tested successfully. Specifically, the vibration mode to be monitored for structural damage was intentionally contaminated with known amounts of another mode, and the response of the trained neural network was measured as a function of the peak-to-peak amplitude of the contaminating mode. The neural network calibration technique essentially uses the vibration mode shapes of the undamaged structure as standards against which the changed mode shapes are compared. The published response of the network can be made nearly independent of the contaminating mode, if enough vibration modes are used to train the net. The sensitivity of the neural network can be adjusted for the environment in which the test is to be conducted. The response of a neural network trained with measured vibration patterns for use on a vibration isolation table in the presence of various sources of laboratory noise is shown. The output of the neural network is called the degradable classification index. The curve was generated by a simultaneous comparison of means, and it shows a peak-to-peak sensitivity of about 100 nm. The following graph uses model generated data from a compressor blade to show that much higher sensitivities are possible when the environment can be controlled better. The peak-to-peak sensitivity here is about 20 nm. The training procedure was modified for the second graph, and the data were subjected to an intensity-dependent transformation called folding. All the measurements for this approach to calibration were optical. The peak-to-peak amplitudes of the vibration modes were measured using heterodyne interferometry, and the modes themselves were recorded using television (electronic) holography.

Author

Calibrating; Neural Nets; Nondestructive Tests; Optical Heterodyning

20050192422 NASA Glenn Research Center, Cleveland, OH, USA

Optical Measurements of Axial and Tangential Steady-State Blade Deflections Obtained Simultaneously

Kurkov, Anatole P.; Dhadwal, Harbans S.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Case-mounted fiber-optic sensors have been used by aircraft engine manufacturers mainly to monitor blade vibration in fans and compressors. The simplest probe arrangement is a spot probe where, typically, a center fiber transmits laser light, and the outer fibers collect the reflected light from the blade tips and transmit it to a photodetector. Because the spot of incident

light is fixed in space, whereas the blade deflects dynamically, the reflected light will originate from slightly different portions of the blade tip under different operating conditions. Unless corrections are developed to compensate for this effect, some error in vibratory tangential amplitude will occur. For monitoring vibrations, this error is usually not critical. However, when steady-state blade deflections are being measured, it is very important to fix the spot on the blade tip at a particular location because the operating speed blade deflections are evaluated against a low-speed reference run. The change in speed usually implies a significant change in the blade orientation and possibly its shape brought about by the aerodynamic and centrifugal loading. It is most convenient to select the blade s leading and trailing edges as the fixed points for which deflections will be evaluated. To capture the blade edges at various speeds, the light probe must be movable. This was achieved by mounting the probe in an eccentric hole in a bushing that fit the fan case in the region that overlapped the path of the blade edge. The probe was actuated to search for a blade edge while all the blades were viewed on an oscilloscope. The blade edge was considered to be captured when a pulse associated with a particular blade was significantly reduced in magnitude but was clearly distinguishable from the background noise level. By tracing the axial position of either blade edge, one could extend the deflection measurement to two dimensions: axial and tangential. These blade deflection measurements were obtained during a wind tunnel test of a fan prototype.
Author
Optical Measurement; Blade Tips; Fiber Optics; Leading Edges; Trailing Edges; Aerodynamic Loads

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PLASMA PHYSICS

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

20050187038 Princeton Univ., NJ USA
Exploiting a Transmission Grating Spectrometer
Bell, R. E.; Dec. 2004; 18 pp.; In English
Report No.(s): DE2005-836478; PPPL-4028; No Copyright; Avail: Department of Energy Information Bridge
The availability of compact transmission grating spectrometers now allows an attractive and economical alternative to the more familiar Czerny-Turner configuration for many high-temperature plasma applications. Higher throughput is obtained with short focal length refractive optics and stigmatic imaging. Many more spectra can be obtained with a single spectrometer since smaller, more densely packed optical input fibers can be used. Multiple input slits, along with a bandpass filter, can be used to maximize the number of spectra per detector, providing further economy. Curved slits can correct for the strong image curvature of the short focal length optics. Presented here are the governing grating equations for both standard and high-dispersion transmission gratings, defining dispersion, image curvature, and desired slit curvature, that can be used in the design of improved plasma diagnostics.
NTIS
High Temperature Plasmas; Plasma Diagnostics; Spectrometers

20050192054 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
Ultraviolet Femtosecond and Nanosecond Laser Ablation of Silicon: Ablation Efficiency and Laser-Induced Plasma Expansion
Zong, X.; Mao, X.; Greif, R.; Russo, R. E.; January 2005; 14 pp.; In English
Report No.(s): DE2005-836676; No Copyright; Avail: Department of Energy Information Bridge
Femtosecond laser ablation of silicon in air was studied and compared with nanosecond laser ablation at ultraviolet wavelength (266 nm). Laser ablation efficiency was studied by measuring crater depth as a function of pulse number. For the same number of laser pulses, the fs-ablated crater was about two times deeper than the ns-crater. The temperature and electron number density of the pulsed laser-induced plasma were determined from spectroscopic measurements. The electron number density and temperature of fs-pulse plasmas decreased faster than ns-pulse plasmas due to different energy deposition mechanisms. Images of the laser-induced plasma were obtained with femtosecond time-resolved laser shadowgraph imaging. Plasma expansion in both the perpendicular and the lateral directions to the laser beam were compared for femtosecond and nanosecond laser ablation.
NTIS
Laser Ablation; Plasmas (Physics); Ultraviolet Lasers

20050192212 NASA Glenn Research Center, Cleveland, OH, USA, Army Research Lab., Cleveland, OH, USA
Electric Plasma Arc-Lamp Combustor Liner Durability Test System Developed
Goldsby, Jon C.; Halbig, Michael C.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Silicon carbide matrix composites are candidate materials for high-temperature combustor liners. Because through-the-thickness thermal gradients are the primary cause of stress on combustor liners, a unique test facility was developed at the NASA Glenn Research Center at Lewis Field to simulate in-service pure thermal stress distributions in fiber reinforced silicon carbide cylinders. It was developed initially under Phase II of the High- Speed Research Program. This test stand can accommodate 8-in.-long test cylinders that have outer diameters of 4 in. and a wall thickness of about 0.08 to 0.12 in. One cylinder at a time is loaded vertically into the test stand. Water-cooled plates enclose the open ends of the cylinder and provide cooling. Load plates on the exterior side of the water-cooled plates provide support and compression loads. To evaluate a combustor liner material s potential performance, researchers induce thermal gradients with an axisymmetric, direct-current, electric arc within the cylinder while refrigerated air at a rate of 1.5 lb/sec impinges on the outside surface of the cylinder. The achievable through-the-thickness thermal gradient is predicted to be in excess of 200 C. The 8-in. long, 0.5-in.-diameter plasma arc emits full spectrum visible light; radiant intensity exceeds 300 Watts per square centimeters to produce temperatures in excess of 1500 C on materials with emissivity near unity. Because the system does not rely upon the combustion of fuels to achieve the related thermal conditions, ancillary environmental reactions with the sample are eliminated. The system incorporates a standard mechanical test frame, which can impose constant as well cyclical axial stresses up to 2200 lb upon the test piece. Silicon-carbide-fiber reinforced silicon carbide matrix composite cylinders were instrumented with thin-film thermocouples to obtain through-the-thickness thermal flux measurements. Inside wall temperatures reached 1200 C with only 250 A of current. One of the special features of this configuration is the creation of hoop stress states within the cylinder, which up this point have not been obtainable in planar coupon tests. This facility will allow various operational modes, including accelerated tests of thermal transients simulating the effects of repeated engine ignition as well as prescribed thermal and mechanical histories to simulate various duty cycle profiles. Tests can now be performed on thermal-barrier-coated metallic liners and ceramic composite liners that require a combination of high heat flux and controlled mechanical stresses.
Author
Arc Lamps; Combustion Chambers; Durability; Linings; Electric Arcs; Plasmas (Physics); Test Facilities

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SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering*; and *36 Lasers and Masers*.

20050187100 Pennsylvania Univ., Philadelphia, PA, USA
Access in Nanoporous Solids
Glandt, E. D.; January 2005; 22 pp.; In English
Report No.(s): DE2005-820070; No Copyright; Avail: Department of Energy Information Bridge

This is an application of techniques of molecular theory to the study of nanostructures build on planar substrates and the face of membranes, with the ultimate goal of modifying their equilibrium and transport behavior. The work is focused on the mechanism for adsorption or deposition and how various regimes can be achieved by changing the rate of adsorption relative to characteristic diffusion and reaction time scales.
NTIS
Membranes; Nanostructures (Devices); Porous Materials; Solids

20050192057 MicroCoating Technologies, Inc., Atlanta, GA, USA
On-Line Texture Diagnostics for Coated Conductor Manufacture
Dec. 30, 2002; 30 pp.; In English
Report No.(s): DE2005-824132; No Copyright; Avail: Department of Energy Information Bridge

This Phase I project was undertaken to assess the feasibility of implementing a particular diagnostic method for characterizing the crystallographic texture of high temperature superconductor (HTS) coated conductors on-line during their reel-to-reel continuous manufacture. Key factors in this technique were the use of an area detector to greatly reduce scan time,

an x-ray mirror to enhance incident beam brightness, and an automation scheme for diffractometer control, tape motion control, and calculation and output of texture characterizations.
NTIS
Coatings; Conductors; Diagnosis; High Temperature Superconductors; On-Line Systems; Textures

20050192404 NASA Glenn Research Center, Cleveland, OH, USA
Web Growth Used to Confine Screw Dislocations to Predetermined Lateral Positions in 4H-SiC Epilayers
Powell, J. Anthony; Neudeck, Philip G.; Spry, David J.; Trunek, Andrew J.; Beheim, Glenn M.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Silicon-carbide- (SiC-) based power devices could enable substantial aerospace electronics benefits over today's silicon-based electronics. However, present-day SiC wafers contain electrically harmful dislocations (including micropipes) that are unpredictably distributed in high densities across all commercial 4H- and 6H-SiC wafers. The NASA Glenn Research Center recently demonstrated a crystal growth process that moves SiC wafer dislocations to predetermined lateral positions in epitaxial layers so that they can be reproducibly avoided during subsequent SiC electronic device fabrication. The process starts by reactive ion etching mesa patterns with enclosed trench regions into commercial on-axis (0001) 4H- or 6H-SiC substrates. An example of a pregrowth mesa geometry with six enclosed triangular-shaped trench regions is shown. After the etch mask is stripped, homoepitaxial growth is carried out in pure stepflow conditions that enable thin cantilevers to grow laterally from the tops of mesas whose pregrowth top surfaces are not threaded by substrate screw dislocations. The image in the bottom figure shows the postgrowth structure that forms after the lateral cantilevers expand to coalesce and completely roof over each of the six triangular trench regions. Atomic force microscope (AFM) measurements of the roof revealed that three elementary screw dislocation growth spirals, each shown in the AFM insets of the bottom image on the previous page, formed in the film roof at three respective points of cantilever film coalescence. The image above shows the structure following an etch in molten potassium hydroxide (KOH) that produced surface etch pits at the dislocation defects. The larger KOH etch pits--S1, S2, and S3--shown in this image correspond to screw dislocations relocated to the final points of cantilever coalescence. The smaller KOH etch pits are consistent with epilayer threading edge dislocations from the pregrowth substrate mesa (P1, P3, and P4) and a final cantilever coalescence point (P2). No defects (i.e., no etch pits) are observed in other cantilevered portions of the film surface. On the basis of the principle of dislocation Burgers vector conservation, we hypothesize that all vertically propagating substrate dislocations in an enclosed trench region become combined into a single dislocation in the webbed film roof at the point of final roof coalescence. The point of final roof coalescence, and therefore the lateral location of a webbed roof dislocation, can be designed into the pregrowth mesa pattern. Screw dislocations with predetermined lateral positions can then be used to provide the new growth steps necessary for growing a 4H/6H-SiC epilayer with a lower dislocation density than the substrate. Devices fabricated on top of such films can be positioned to avoid the preplaced dislocations.
Author
Epitaxy; Fabrication; Screw Dislocations; Silicon Carbides; Crystal Growth

77
PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

20050187107 California Univ., Los Angeles, CA, USA, Brookhaven National Lab., Upton, NY USA
Progress in Designing a Muon Cooling Ring with Lithium Lenses
Fukui, Y.; Cline, D. B.; Garren, A. A.; Kirk, H. G.; Nov. 2003; 8 pp.; In English
Report No.(s): DE2004-15007040; BNL-72150-2004-CP; No Copyright; Avail: Department of Energy Information Bridge

We discuss particle tracking simulations in a storage ring with lithium lens inserts designed for the six-dimensional phase space cooling of muons by the ionization cooling. The ring design contains one or more lithium lens absorbers for transverse cooling that transmit the beam with very small beta-function values, in addition to liquid-hydrogen wedge-shaped absorbers in dispersive locations for longitudinal cooling. Such a ring could comprise the final component of a cooling system for use in a muon collider. The beam matching between dipole-quadrupole lattices and the lithium lenses is of particular interest.
NTIS
Muons; Storage Rings (Particle Accelerators); Cooling; Lithium; Lenses

20050187109 George Washington Univ., Washington, DC, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

Coherent Pion Photoproduction on Deuterium

Ilieva, Y.; Sep. 23, 2003; 8 pp.; In English

Report No.(s): DE2004-829609; No Copyright; Avail: Department of Energy Information Bridge

Differential cross sections of the gamma + d -\g d + pi(up 0) reaction were measured at photon beam energies between 0.5 and 2.0 GeV over a wide angular range in CM system. The experiment was performed in Hall B at Jefferson Lab using the CLAS detector. The excitation function, especially at backward CM scattering angles, has been studied with regard to effects due to intermediate on-shell eta and omega rescattering. At CM scattering angles greater than 123 deg our data clearly show an enhancement around 0.7 GeV, which could be attributed to an intermediate on-shell eta-state.

NTIS

Pions; Deuterium; Photoproduction

20050187112 College of William and Mary, Williamsburg, VA, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

Some Electromagnetic Properties of the Nucleon from Relativistic Chiral Effective Field Theory

Pascalutsa, V.; Dec. 01, 2004; 16 pp.; In English

Report No.(s): DE2004-834800; No Copyright; Avail: Department of Energy Information Bridge

Considering the magnetic moment and polarizabilities of the nucleon we demonstrate the need for relativistic chiral EFT calculations. Our relativistic calculations are done via the forward-Compton-scattering sum rules, thus ensuring the correct analytic properties. The results obtained in this way are equivalent to the usual loop calculations, provided no heavy-baryon expansion or any other manipulations which lead to a different analytic structure (e.g., infrared regularization) are made. The Baldin sum rule can directly be applied to calculate the sum of nucleon polarizabilities. In contrast, the GDH sum rule is practically unsuitable for the calculation of the magnetic moments. The breakthrough is achieved by taking the derivatives of the sum rule with respect to the anomalous magnetic moment.

NTIS

Chirality; Electromagnetic Properties; Nucleons; Magnetic Moments

20050188494 NASA Lewis Research Center, Cleveland, OH, USA

Angular Distribution of Elastically Scattered Electrons Determined and Its Effect on Collector Performance Computed

Krainsky, Isay L.; Vaden, Karl R.; Research and Technology 1998; April 2005; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

It has been demonstrated that the suppression of secondary electron emission significantly improves the performance of electron beam collectors (ref. 1). However, a complete analysis of the effects of secondary electron emission with respect to collector performance has not been possible because of the lack of quantitative data on angular distributions of secondary electrons. Secondary electrons are emitted with energies ranging from near zero to the energy of the incident primary. For our purposes, we define elastically scattered electrons as secondary electrons within 20 percent of the incident energy. Elastically scattered electrons are of great concern because their energy allows them to follow trajectories that can carry them almost anywhere within the vacuum envelope. If these secondaries leave the collector and reenter the slow wave circuit, they can produce undesired signal distortion and oscillation.This apparatus, which was built by Krainsky (ref. 2), was used at the NASA Lewis Research Center to obtain detailed measurements of the angular distributions of elastically scattered secondaries. Data were obtained for three surfaces of significant interest to collector applications: highly polished copper, copper roughened by ion sputtering, and isotropic graphite. Lewis researchers discovered that elastically scattered electrons have a complex angular distribution that is strongly dependent on the atomic number and surface morphology of the target material, as well as the energy and angle of incidence of the primary beam. At low energies, secondary emission from polished copper in the chosen energy range is primarily directed back to the source of primary electrons (backscattering). Forward scattering increases with primary energy until, at high energies, forward scattering dominates the angular distribution. Although back-scattered secondaries dominate the distributions of the textured copper surface, the yield is substantially lower. From the standpoint of secondary emission, isotropic graphite is the most attractive material because it exhibits low yield and little back scattering. Derived from text

Electron Emission; Elastic Scattering; Secondary Emission; Electron Beams

20050189246 Argonne National Lab., IL USA, Massachusetts Inst. of Tech., Cambridge, MA, USA, College of William and Mary, Williamsburg, VA, USA

Cross Section Measurement of Charged Pion Photoproduction in Hydrogen and Deuterium from 1.1 to 5.5 GeV

Zhu, L. Y.; Arrington, J.; Averett, T.; Beise, E.; Calarco, J.; Nov. 2004; 24 pp.; In English

Report No.(s): DE2005-0409018; No Copyright; Avail: Department of Energy Information Bridge

No abstract available

Deuterium; Hydrogen; Photoproduction; Pions

80
SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula. For specific topics in these areas see *categories 81 through 85*.

20050189178 Syracuse Univ., NY USA

Advanced Course in Engineering (ACE)

Jabbour, Kamal; Apr. 2005; 38 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8750-04-1-0208; Proj-GRIF

Report No.(s): AD-A434301; AFRL-IF-RS-TR-2005-142; No Copyright; Avail: CASI; A03, Hardcopy

Syracuse University completed the requirements for this grant and successfully delivered a turn-key summer Advanced Course in Engineering on Cyber Security at the Rome Research Site. They recruited and selected students, developed the curriculum, hired the faculty, delivered the instruction and evaluated the students. In addition, we placed the students in internship at the lab and affiliated contractors, where they worked on projects related to cyber security challenges of Homeland Security.

DTIC

Security; Computer Information Security; Education

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20050187114 Texas Commission on Environmental Quality, Austin, TX, USA

Texas Commission on Environmental Quality Information Technology Detail for Fiscal Years 2006 and 2007

Aug. 20, 2004; 144 pp.; In English

Report No.(s): PB2005-107692; SFR-028/06; No Copyright; Avail: CASI; A07, Hardcopy

The mission of the Texas Commission on Environmental Quality states 'The Texas Commission on Environmental Quality' strives to protect our state's human and natural resources consistent with sustainable economic development. Our goal is clean air, clean water and the safe management of waste. This summary ties the Information Technology plan to the budget and outlines how the TCEQ addresses agency needs in accordance with its mission.

NTIS

Environmental Quality; Information Systems; Project Management

20050187115 Federal Aviation Administration, Washington, DC USA

Building on the Legacy: A Year of Change, New Challenges, Performance and Result

January 2005; 114 pp.; In English

Report No.(s): PB2005-107488; No Copyright; Avail: CASI; A06, Hardcopy

In February 2004, the FAAs Air Traffic Organization (ATO) became a reality and the Human Factors Research and Engineering Division, along with other legacy research offices, was aligned with the Operations Planning Service Unit (ATO-P). The ATO combined the Research and Acquisitions, Air Traffic Services, and Free Flight offices into one performance-based organization. This innovative achievement was necessary for the FAA to keep pace with industry and to operate effectively with reduced revenues. With this restructuring, the ATO became responsible for the direct, daily management of the Nation's air traffic control system. This new structure provides alignment and focus of resources at point of delivery and subsequently improves speed, flexibility, response and efficiency. The ATO faces many new challenges, and

will need great cooperative efforts in three major areas to maintain its momentum in coming years: (1) to improve safety, even with growing congestion at major hub airports; (2) to reduce costs, even as our workload increases; and, (3) to optimize services to our customers, even as they struggle through a period of dynamic aviation industry change.
NTIS
Air Traffic Control; Air Transportation; Aircraft Safety; Airports; Flight Safety; Management Planning

20050192318 NASA Langley Research Center, Hampton, VA, USA, StarNet, LLC, USA
An Assessment of the Effectiveness of the AGATE Program Management Model
Warner, Timothy P., Technical Monitor; Masson, Paul; July 2005; 44 pp.; In English
Contract(s)/Grant(s): WU 23-786-80-10; L-70960D
Report No.(s): NASA/CR-2005-213275; No Copyright; Avail: CASI; A03, Hardcopy

This report describes the collaborative program model chosen to implement an aeronautics research and technology program from 1994 through 2001: the Advanced General Aviation Transport Experiments (AGATE) Program. The Program had one primary objective: to improve the ability of the General Aviation industry to adopt technology as a solution to fulfill public benefit objectives. The primary objective of this report is to assess the program s ability to meet a combination of 'effectiveness measures' from multiple stakeholders. The 'effectiveness' of any model forms the foundation of legitimate questions for policy makers and professional federal managers. The participants rated AGATE as achieving its primary objectives and rating well on effectiveness in most areas, with high measures for relevance, cost, speed and public benefit, but lower measures for institutional fit and flexibility at dealing with the larger NASA organizational structure. This pattern mirrors private sector surveys and represents a tradeoff between the benefits of tailoring a program using partnering, versus the changes necessary within the institutional structure to support such tailoring.
Author
General Aviation Aircraft; Aircraft Industry; Project Management; Policies; Aeronautical Engineering

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DOCUMENTATION AND INFORMATION SCIENCE

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

20050186912 Defence Science and Technology Organisation, Edinburgh, Australia
Coalition Theatre Logistics (CTL) Advanced Concept Technology Demonstration (ACTD) Coalition Movement Requirements Plan Web Service Documentation
Forster, Peter; Kuster, Egon; March 2005; 45 pp.; In English
Report No.(s): DSTO-TN-0618; DODA-AR-013-355; Copyright; Avail: Other Sources

This document describes the Coalition Movement Requirements Plan Web Service used within the Coalition Theatre Logistics Advanced Concept Technology Demonstrator (CTL-ACTD) as developed by DSTO. Build and installation instructions are also included to deploy the web service in the CTL-ACTD Coalition Server.
Author
Logistics; World Wide Web; Technology Utilization; Information Management

20050186937 Committee on Science and Astronautics (U.S. House), Washington, DC, USA
Is Space the Way to Peace and Abundance?
Anfuso, Victor L.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 1-4; In English; See also 20050186936; Copyright; Avail: Other Sources

As a member of the Science and Astronautics Committee of the U.S. House of Representatives, I feel that on this occasion we can share a few thoughts together of mutual interest. Let us first face the fact that never in its history has the world been so near to destroying itself; that never before has so much deception in diplomacy been practiced and that never has there been so much talk of peace, while all the planning is for war. The situation is like inviting someone to your home for dinner, while making arrangements for his demise. It is in this kind of world that we must seek the ingredients for peace. We know that man has already discovered a new world--many times larger than the world COLUMBUS found but it is one of unexplored horizons. We have opened the door to 'the Heavens' pathless way.' The questions now being asked are these: _Vill, what we find there, be good or evil ? Will it prove to be a boon to humanity, or are we getting nearer to the day of destruction .z As we look back over the recent past, it is hard to believe that man's efforts to penetrate outer space came to fruition less than

two years ago. Prior to that time, most people regarded satellite orbits and interplanetary travel as nothing more than the fantasies of children or visionaries, of comic-strip cartoonists or science-fiction writers. During these past two years everyone has come to recognize that the practicality of space flight has been demonstrated. The impact of all this on people's minds has been unprecedented. Of all the wonders wrought by the progress of science and technology, it seems to me that none before--not even nuclear energy--has opened such vistas for mankind. Certainly none has ever promised to free us, while still alive, from the Earth itself. At this great international gathering, it is fitting to review the material benefits, in new knowledge and the practical applications thereof, which we may reasonably expect from man's future explorations in outer space. No less important is it for us to consider the prospects that may be offered for permanent world peace. But we must not let ourselves be so dazzled by these glittering possibilities that we forget the deeper meaning of our emergence into outer space. I refer, of course, to man's moral sense, his curiosity and capacity for wonder, his faith and reverence in God, and his spirit of adventure.

Author

Research and Development; Warfare; Technologies; Destruction; Deception

20050186947 Centro de Estudos Astronauticos, Lisbon, Portugal

Dynamical Limitation of the Freedom of Space

Fonseca, Eurico; Proceedings of the Second Colloquium on the Law of Outer Space; [1960]; In English; See also 20050186936; Copyright; Avail: Other Sources

Since the publication of MANDLS 'Weltraumrecht,' a quarter of a century ago, many works on Space Law have come out. Yet, despite the hard work carried out by the IAF and the United Nations Organization, it has not been possible up to now to come to an agreement about the establishment of the boundaries within which Space Law is to be applicable. According to JOHN COBB COOPER the vertical range of sovereignty is naturally determined by the scientific progress of nations. Of course this is a realistic criterion certainly inspired by the early cannon-shot thesis which permitted to set the limits of territorial waters. We must notice, however, that in the latter case, the artillery range being then nearly the same for all the batteries, this led to a boundary that practically remained fixed. In outer space where gravitational fields decrease according to NEWTONS law, the amount of energy necessary to reach a spot 6,400 kms or 900,000 kms away from Earth, on TISSERANDS equigravitational sphere, is practically the same. In this connection, the literal acceptance of COOPERS thesis could provide a given country with a fair excuse to oppose, say, the refueling of a lunar base or an orbital station while they remained above its territory. This accounts for the need, supported since long by CROCCO, of an effective limitation of the vertical sovereignty and the establishment of a higher zone within which space travel should be allowed, like intercontinental travel on the high seas nowadays. Generally speaking it is agreed that the space range up to 50 kilometers altitude, i.e. the so called effective atmosphere, is a property of the country lying below. At 250 or 300 kms (LEYs quoted thesis) or even up to 800 kilometers (HALEYS thesis) the limits of an adjoining zone within which there would be the freedom of innocent passage, should be set. Above this zone space would be free, like the high seas. This point of view presents an obvious disadvantage. The quickness of passage and the ballistic nature of the trajectory of spaceships make a direct inquiry about their innocence impossible. Indirect investigation through the inspection of the launching bases must be left out as quite impracticable, the launching vehicles being as a rule a result of the adaptation of missiles, and because of the great difficulty of distinguishing between the innocence or non-innocence of the instruments they carry. There is still another point to observe: the delimitation expressed through a given altitude aims, as it seems, to consider as free the space within which the orbits of man-made satellites are situated.

Author (revised)

Ballistic Trajectories; Gravitational Fields; Space Law

20050187033 Department of Justice, Washington, DC, USA

Follow-Up Review of the Status of IDENT/IAFIS Integration

Dec. 2004; 128 pp.; In English

Report No.(s): PB2005-106942; REPT-I-2005-001; No Copyright; Avail: CASI; A07, Hardcopy

USA immigration authorities have long recognized the need for an automated fingerprint identification system to quickly determine the immigration and criminal histories of aliens they apprehend. However, the inability of immigration and law enforcement fingerprint identification systems to share information prevents law enforcement agencies from identifying criminals and wanted aliens in their custody, and has led to tragic results in some cases. Congress has expressed increasing concern that the Federal Bureau of Investigations (FBI) Integrated Automated Fingerprint Identification System (IAFIS) and the Department of Homeland Security's (DHS) Automated Biometric Identification System (IDENT) have not been integrated. After the terrorist attacks of September 11, 2001, Congress required that the fingerprint identification systems of law

enforcement agencies be made interoperable so that criminals and known or suspected terrorists can be more readily identified.
NTIS
Systems Integration; Law (Jurisprudence); Identifying

20050187057 Institute of Museum and Library Services, Washington, DC, USA
African American History & Culture in Museums: Strategic Crossroads and New Opportunities
Jul. 2004; 24 pp.; In English
Report No.(s): PB2005-107719; No Copyright; Avail: CASI; A03, Hardcopy

The Institute of Museum and Library Services is dedicated to creating and sustaining a Nation of Learners by helping libraries and museums serve their communities. African American museums are eligible for grants from IMLS and can use them to strengthen their public service, care of collections, staff development and leadership activities.
NTIS
Africa; Libraries; Museums

20050188443 Federal Bureau of Prisons, Washington, DC, USA
Symposium on Criminal Justice Information Systems and Technology (1994): Building the Infrastructure. The Design, Development, and Maintenance of Executive Information Systems for Corrections, Probation and Parole
Saylor, W. G.; January 1994; 14 pp.; In English
Report No.(s): PB2005-107042; No Copyright; Avail: CASI; A03, Hardcopy

This presentation will address issues related to the design, development and maintenance of executive information systems (EIS). I will define the concept of an EIS, and discuss why I believe it is critical for agencies like ours to invest in these types of information systems. I will also describe what is required to develop and maintain such systems, and what it costs, at least in some relative terms. Design and development issues will address personnel considerations (e.g., agency verses contract), tailoring the system to the organization's mission and goals, defining measures of organizational performance, data requirements, and software and hardware options. I will also discuss the use of EIS in support of budget justification, strategic (long range) planning, management decision support, performance monitoring, policy impact assessment, and responding to routine and ad hoc information requests.
NTIS
Conferences; Information Systems; Management Planning; Computer Programs

20050189163 Oklahoma Univ., Norman, OK USA
Biotechnology for the Environment
Suflita, Joseph M.; Wall, Judy D.; Jun. 2005; 10 pp.; In English
Contract(s)/Grant(s): N00014-03-1-0316
Report No.(s): AD-A434501; No Copyright; Avail: CASI; A02, Hardcopy

The EU-US Task Force on Environmental Biotechnology obtained support for short-term transatlantic exchanges of early career scientists designed to foster collaborative interactions and to enhance the professional development of the exchange fellows through the acquisition of expertise in microbial biotechnology. Not all of the available funds were expended. Travel worldwide is only now approaching pre-September 11, 2001 levels. Funds received from the ONR were exhausted during this round of exchanges while NSF granted a no-cost extension for one year. The DOE refused a no-cost extension request and steps are underway to returned the unexpended funds. Five participants received funds for exchange research visits in EU laboratories, in addition to the eleven fellows funded during the first round of exchanges. This program continues to meet the mission of fostering the collaborative exchange of scientific talent between the USA and the European Union.
DTIC
Biotechnology; Contamination; Hazardous Materials

20050189165 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Exploratory Inquiry: Disparate Air Force Base Area Network Architectures
Boyd, Charlie W., Jr; Mar. 2005; 122 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434436; AFIT/GIR/ENV/05M-01; No Copyright; Avail: Defense Technical Information Center (DTIC)

Joint Vision 2020, the Department of Defense (DoD) blueprint for development and transformation, identifies information and technology as critical enablers for our nation's military and calls for the development of a joint force capable of integrated information sharing to provide decision superiority, the ability to make and implement better decisions before enemies can

react (DoD, 2000). Networks have been identified as the single most important element for transforming our current military forces. Ironically, Air Force base-level communications networks have been identified as a weakness. This research follows the qualitative approach to increases the current understanding of base level communications networks by conducting a multiple site comparative case study that includes practitioner interviews at four locations and the examination of existing literature and documented trip reports. This study determines if base- level networks are disparate, isolates sources of disparity, identifies advantages and disadvantages of disparity, and recommends an appropriate course of action. This research is significant for members of the Air Force, DoD, and private citizens. Air Force networks support close to three-quarters of a million users, including active duty service members, Air Force Reserves, Air National Guard, civilians, and embedded contract employees (McCarter, 2003). In addition to potentially affecting many people and the larger DoD network, base-level networks provide support to deployed warfighters and provide the environment to train, organize and equip our forces. Additionally, these networks provide critical information to key decision makers.
DTIC
Decision Making; Information Systems; Systems Integration

20050189185 Naval Research Lab., Washington, DC USA
NRL Fact Book
Schubert, David M.; Dec. 2004; 131 pp.; In English; Original contains color illustrations
Report No.(s): AD-A433700; NRL/PU/3430-04-465; No Copyright; Avail: Defense Technical Information Center (DTIC)

The NRL Fact Book is a reference source for information about the Naval Research Laboratory (NRL). It is updated annually and the revised version is placed on NRL's Web site (http://www.nrl.navy.mil) each year. It is printed every other year. The Fact Book contains the following sections: an introduction to the Naval Research Laboratory, including its mission, current research, and major research capabilities and facilities; the Executive Directorate; the Business Operations Directorate; Systems Directorate; Materials Science and Component Technology Directorate; Ocean and Atmospheric Science and Technology Directorate; Naval Center for Space Technology; Technical Output, Fiscal, and Personnel Information; Professional Development; and General Information.
DTIC
Navy; Information; Research and Development

20050189186 Army Research Office, Research Triangle Park, NC USA
2004 Army Research Office in Review
Jan. 2004; 321 pp.; In English; Original contains color illustrations
Report No.(s): AD-A434602; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report is intended to be a single-source document describing the U.S. Army Research Office (ARO) research programs for FY04. It includes: A brief review of the strategy employed to guide ARO research investments and noteworthy issues affecting the implementation of that strategy; Statistical information on 6.1 funding and program proposal activity; and Research trends and accomplishments of the individual ARO scientific divisions.
DTIC
Research Management; Research and Development; Military Technology

20050189209 NASA Langley Research Center, Hampton, VA, USA
NASA Publications Guide for Authors
July 2005; 57 pp.; In English
Contract(s)/Grant(s): WU 23-104-05-20-30
Report No.(s): NASA/SP-2005-7602/REV1; L-19145/REV1; No Copyright; Avail: CASI; A04, Hardcopy

This document presents guidelines for use by NASA authors for preparing and publishing their scientific and technical information (STI). Section 1 gives an overview. Section 2 describes each type of report in the NASA STI Report Series and other forms of publications. It also discusses dissemination and safeguarding of STI. Section 3 gives technical, data quality, and dissemination reviews, including the mandatory review via NASA Form 1676, NASA Scientific and Technical Information (STI) Document Availability Authorization (DAA). It also describes handling unlimited and limited/restricted STI. Section 4 provides recommended standards for document format, composition, and organization and element of a typical report. Section 5 presents miscellaneous preparation recommendations. Section 6 discusses two required forms, Standard

Form 298 and NF-1676. The guide cites additional sources of information of standards, guidelines, and review and approval requirements.
Author
NASA Programs; Information Dissemination; Documents

20050192304 National Highway Traffic Safety Administration, Washington, DC, USA
State Data System Crash Data Report: 1990-1999
Jul. 2002; 440 pp.; In English
Report No.(s): PB2005-107124; No Copyright; Avail: CASI; A19, Hardcopy

This report presents descriptive statistics summarizing motor vehicle traffic crashes that occurred from 1990-1999 in each of the seventeen states that participate in the State Data System, as well as other useful information about state crash data. These data are not representative of the nation as a whole, but do provide a comprehensive and illustrative census of motor vehicle crash patterns and trends in 17 states. Crash statistics are presented in ten sections. General information can be found in the first three sections: Crashes, Vehicles, and People. The remaining sections focus on more specific data subsets. Sections 4 and 5 present alcohol- and speeding-related crash summary data. Specific vehicle actions and types are presented in Sections 6-8 (Rollovers, Motorcycles, and Large Trucks). Finally, Section 9 provides additional information regarding the ages of persons who were killed and injured, while Section 10 focuses on vehicle safety equipment. State data availability, to include vehicle identification number (VIN) availability, is provided in Appendix A. Other state-specific information is given in the Appendices B-G.
NTIS
Crashes; Data Management; Data Systems; Highways; Motor Vehicles

20050192462 NASA Langley Research Center, Hampton, VA, USA
NASA Patent Abstracts Bibliography: A Continuing Bibliography, Supplement 66
July 2005; 38 pp.; In English; Original contains black and white illustrations
Report No.(s): NASA/SP-2005-7039/SUPPL66; No Copyright; Avail: CASI; A03, Hardcopy

This report lists NASA patent abstracts recently announced in the NASA STI Database.
Author
Bibliographies; Patents; Abstracts

83
ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

20050186944 Sociedade Interplanetaria Brasileira, Sao Paulo, Brazil
The Impact of Spaceflight on World Economy
Bun, Thomas Pedro; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 17-18; In English; See also 20050186936; Copyright; Avail: Other Sources

Human endeavour has always shown a marked trend towards new possibilities. Man puts his biggest stake on the yet unconquered. Wherever he finds a new way to go, he will spare no effort until he manages to get there. This is one of the main motives behind the currently ever-increas'mg expenses for human spaceflight. There is now, and will undoubtedly be in the future, an ever bigger drain on our resources, in order to finance this newest human endeavour. The particular form of this drain, however, is at present assuming a shape which is neither practical nor efficient, i.e. through the channels of separately existing national efforts within the particular nations' military budgets. The unmistakable trend in present world economy is toward a more appropriate way of handling big enterprises: by permitting international bidding the best proposal is quickly found and a more satisfactory result is obtained at a lower cost. In this way many large engineering jobs are satisfactorily carried out. New industrial set-ups including atomic energy installations have found this method highly commendable, practical and efficient. For this reason we suggest the establishment of a World Agency by all nations interested in effecting spaceflight, an agency that would be in charge of organizing the venture. By inviting international tenders this agency would find the best firms on the world market for providing rocket propulsion units, guidance and instrument equipment etc. If one

nation excels in producing huge motors, another might do better on tiny components. The overall result will be an unimpeded acceleration in development.
Author
Space Flight; Cost Reduction; Nuclear Electric Power Generation; Finance

20050188548 NASA Lewis Research Center, Cleveland, OH, USA
Broadband Satellite Technologies and Markets Assessed
Wallett, Thomas M.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The current usage of broadband (data rate greater than 64 kilobits per second (kbs)) for multimedia network computer applications is increasing, and the need for network communications technologies and systems to support this use is also growing. Satellite technology will likely be an important part of the National Information Infrastructure (NII) and the Global Information Infrastructure (GII) in the next decade. Several candidate communications technologies that may be used to carry a portion of the increased data traffic have been reviewed, and estimates of the future demand for satellite capacity have been made. A study was conducted by the NASA Lewis Research Center to assess the satellite addressable markets for broadband applications. This study effort included four specific milestones: (1) assess the changing nature of broadband applications and their usage, (2) assess broadband satellite and terrestrial technologies, (3) estimate the size of the global satellite addressable market from 2000 to 2010, and (4) identify how the impact of future technology developments could increase the utility of satellite-based transport to serve this market.
Derived from text
Satellite Communication; Broadband; Internets; Market Research; Technology Assessment

84
LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

20050186936 International Astronautical Federation, Washington, DC, USA
Proceedings of the Second Colloquium on the Law of Outer Space
Haley, Andrew G., Editor; Heinrich, Welf, Editor; [1960]; 186 pp.; In English; Second Colloquium on the Law of Outer Space, 4 Sep. 1959, London, UK; See also 20050186937 - 20050186957; Copyright; Avail: Other Sources

Topics discussed include: Is Space the Way to Peace and Abundance?; The Future of National Sovereignty; Toward Solving the Space Sovereignty Problem; The Impact of Spaceflight on World Economy The Report of the United Nations Legal Committee on the Peaceful Uses of Outer Space: A Provisional Appraisal; Dynamical Limitation of the Freedom of Space; The Behavioral Sciences in the Space Age; The United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space. Accomplishments and Implications for Legal Problems; The Question of Freedom of Innocent Passage of Space Vehicles of one State through the Space above the Territory of another State which is not Outer Space; Space Exploration--the Problems of Today, Tomorrow and in the Future; Some Rules Regulating Earth-to-Earth, Space-to-Earth and Earth-to-Space Missiles and Interplanetary Vehicles; Legal Problems of Outer Space. U.S.A. and Soviet Viewpoints; Space Exploration--Some Legal and Political Aspects; The Legal Status of Unmanned Space Vehicles; and Some Problems Relating to Space Law.
Derived from text
Space Exploration; Space Law; United Nations; Missiles; Sovereignty; Space Flight

20050186938 Heidelberg Univ., Heidelberg, Germany
World Space Law: The Basic Principles for Its Codification
vonRauchhaupt, W.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 125-128; In English; See also 20050186936; Copyright; Avail: Other Sources

The present material for questions of Space Law is' 1. taken empirically from Public International Law, from Air Law, Maritime Law, Constitutional and the Administrative Law of the modern States on our Earth and from the Philosophy of Law. 2. A codification of public international law has not yet been achieved. Essays on how to begin with the universal system or with single problems an d add them up to a total codification were likewise unsuccessful. But some treaties on the laws of war, such as The Hague Convention were accepted by most states, though not always obeyed. In space law there are still many unknown facts and factors, viz. the exact areas or the space where the laws are to be applied, and the laws themselves that are to be applied. Therefore a search for the principles to be adopted and followed is advisable and their systematic collection

has to be attempted. a) There are already some 90 national laws referring to space law and some 20 international treaties, e.g. the International Civil Aviation Convention that prohibits the sending or flying of unmanned (or space vehicles) over the territory of the signatory states. This was permitted, however, by tacit consent during the International Geophysical Year. There are also innumerable articles in scientific and popular reviews, and a few most useful collections of such publications have been published, e.g. the U.S. Senate Symposium on Space Law of 31 December 1958. b) Specific questions deal with regular necessities such as the safety of the vehicles, the crew, the passengers, the goods they carry, the times and ways of departure and of arrival, the national flag and in case of damage done the costs forfeited,--and its civilian non-military purpose in general. c) It would be most useful to investigate and formulate the basic principles of the law to be applied in space as a preparation for a detailed codification. II. The system to be followed may start as a working hypothesis from public international law and some of its applicable parts, e.g. air law, maritime law, the law of peace and war, in particular constitutional law concerning the territory, the people and the sovereignty of the state and, to conclude with, the logic of the philosophy of law in general.
Author
Air Law; Civil Aviation; Coding; International Law; Public Law; Space Law

20050186939 Library of Congress, Washington, DC, USA
Legal Problems of Outer Space: USA and Soviet Viewpoints
Kucherov, Samuel; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 64-74; In English; See also 20050186936; Copyright; Avail: Other Sources

The necessity of an international agreement on a legal status of outer space is now accepted by an overwhelming majority of specialists in the field. It is also clear that an agreement can be reached only if the two most powerful nations active in outer space, the U.S.A. and the U.S.S.R., find a way to adjust their present divergent opinions on the subject. If the legal status if outer space remains undefined, if the problem is relegated to the group of unsolved problems of international law as, for instance, the width of territorial seas, disarmament, etc., it would unavoidably become the source of international disputes and complications. The purpose of the present paper is to compare the American and Soviet viewpoints of some of the legal problems of outer space and to point out the differences and similarities as reflected in the writings and pronouncements of scholars and officials of the two nations and to make suggestions about the work of the Permanent Legal Committee of the IAF.
Author
Agreements; International Cooperation; International Law

20050186940 Central School of Foreign Service, Warsaw, Poland
The Legal Status of Unmanned Space Vehicles
Machowski, Jacek; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 111-119; In English; See also 20050186936; Copyright; Avail: Other Sources

In the situation currently existing in the field of space law, analogies have often been made between legal institutions and rules already in force and those of space law, which are only now being developed. Certain lawyers who are trying, for instance, to establish a line of demarcation between airspace and outer space, call attention to the rules of maritime law; others are finding analogies between manned spaceships and aircraft, or between manned space stations and seadromes (airdrome islands), et cetera. In space law the greatest difficulties so far have perhaps arisen in finding a proper analogy in order to define the legal status of different kinds of unmanned space vehicles. The solution of this particular question seems to be at present of the utmost practical importance because, so far, all the man-made vehicles launched into space have been unmanned. This has been the case with all kinds of space vehicles known to date, such as rockets and missiles which have reached outer space in their flights, the artificial satellites, as well as the two artificial planets launched by the Soviet Union and the USA, respectively. First of all, I would like to explain the major reasons for making an express distinction between manned and unmanned space vehicles. Such a distinction has been made in the provisions of air law, which in its rules makes an express distinction between unmanned aircraft and aircraft flown by a pilot. It seems therefore advisable to make a similar distinction in space law and to separate the study of the legal status of unmanned space vehicles from that of space vehicles flown by a crew. Such an approach towards this problem has already been made by several distinguished lawyers dealing with space law problems (REGALA, DA_I_.R, S_PORTA, Lv.VrrT, CHENG and others). I would like to discuss here some of the specific legal problems linked with the launching of unmanned space vehicles.
Author
Air Law; Pilotless Aircraft; Space Law

20050186941 Committee on Science and Astronautics (U.S. House), Washington, DC, USA

The Future of National Sovereignty

Beresford, Spencer M.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 5-10; In English; See also 20050186936; Copyright; Avail: Other Sources

Until recently, most discussions of space law have dealt with the upper limit of national sovereignty. At other times and places, I have stated my view that the definition of 'aircraft' in the Annexes to the Chicago Convention [1], which is today the only generally accepted international flight agreement, does not apply to satellites or other spacecraft [2]. I have also suggested that the legal distinction between airspace and outer space need not coincide with any physical boundaries, and in any event should be determined by scientific, economic, military and political considerations [3]. In the present paper, I propose to explore whether and to what extent the concept of national sovereignty is likely to remain useful from this point of view, especially in terms of national security. My observations on this subject are personal and not official. The law of the sea often provides a starting point for discussing the law of outer space. In simpler times, a distance of 3 miles was taken as the limit of national sovereignty at sea. According to many historians, this distance was chosen because it was then regarded as the greatest possible range of shore batteries [4]. In any event, the apparent purpose of offshore jurisdiction was defense, and its extent was limited by effective control. The 3-mile offshore limit, however, has been riddled with exceptions and stretched by claims and practices. International law recognizes a qualified right of innocent passage through territorial waters [5]. There are special rights for such matters as fishing and the exploitation of minerals in the Continental Shelf. A 4-mile limit has been recognized by the International Court of Justice [6]. Since 1790 the USA has claimed jurisdiction for customs purposes in a contiguous zone extending up to 12 nautical miles from the coast [7]. In addition, it has established defense identification zones for ships and aircraft in contiguous waters beyond the limits of the territorial sea [8]. Last year, at the United Nations Conference on the Law of the Sea, many nations contended for a 12-mile limit, some for a limit as high as 200 miles [9]. The 3-mile limit still survives, but only for lack of agreement on an alternative. Vertical sovereignty is even more unsettled. In the air, no upper limit of sovereignty was ever recognized. Although early air lawyers advocated 'freedom of the air' [10], the principle of air sovereignty was proclaimed in both the Paris and the Chicago Conventions [11]. The apparent purpose of air sovereignty, like that of jurisdiction in the marginal sea, is chiefly national defense. Both the Paris Convention (1919) and the Chicago Convention (1944) were strongly influenced by the wartime experience of danger from the air.

Author

International Law; Sovereignty; Space Law; Agreements; Airspace; Continental Shelves; International Cooperation

20050186942 Canadian Astronautical Society, Montreal, Quebec, Canada

Toward Solving the Space Sovereignty Problem

Binet, Henri T. P.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 11-16; In English; See also 20050186936; Copyright; Avail: Other Sources

Inevitably when politics are involved, discussions are prolonged. However, the world has grown accustomed to such situations, and will show patience provided tangible results are shown in good time. Perhaps in this respect the United Nations could derive useful support and assistance from other less politically-minded bodies, such as the Permanent Legal Committee of the International Astronautical Federation. Some satisfaction would be felt if there could be carried out, as a beginning, an official survey of the topics upon which international agreement is most urgently needed. These could cover, for instance, the following items: Liability for injury to persons and damage to property resulting from the launching or return to earth of rockets, missiles and other space vehicles; registration and identification of all spacecraft; radio communications; space exploration rules, etc., and other topics suggested by the U.N. Ad Hoc Committee.

Author

Agreements; Space Exploration; Sovereignty; International Cooperation; Politics; Liabilities

20050186943 Cologne Univ., Germany

Some Problems Relating to Space Law

Meyer, Alex; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 120-122; In English; See also 20050186936; Copyright; Avail: Other Sources

Following the procedure adopted at the First Colloquium held at the Hague in 1958, each of the panel members is to speak briefly on some problem concerned with the laws of outer space, including such vital matters as those involved in international cooperation, and thus set the pattern for the ensuing general debate. I should like to draw your attention to three questions which seem to me suitable for a discussion. The /irst question relates to the views expressed on the limits of sovereignty in the space above the earth. In this respect I read in the Staff Report of the 'Select Committee on Astronautics and Space

Exploration of the U.S. House of Representatives' of the 86th Congress, 1st Session, published under the title 'Survey of Space'. 'Officials in the Department of State and Defense have steadfastly held the view that the U.S. at present recognizes no particular limit as to the extent of its sovereignty in space.' In the same sense the Legal Adviser of the State Department, Mr. LOFTUs BECKER, stated in his article 'Major Aspects of the Problem of Outer Space', published in the Department of State Bulletin, June 9, 1958.' Although the U.S. has plainly asserted its complete and exclusive sovereignty over the airspace above its territory, we have at no time conceded that we have no rights in the higher regions of space.' On the other side a Soviet spokcesman announced: 'that the outer altitude of space sovereignty must be established in such a manner as to protect the state against encroachments on its territorial sovereignty'. Both statements invite criticism. There can be no doubt that a state can exercise sovereignty only in a defined territory. But as far as I know there is consent of opinion that it is not possible--not even by drawing fictitious national border lines--to establish above the borders of a state a defined territory in outer space which would correspond to the respective boundaries of this state on earth. The enormous distances between the surface of earth and outer space--in connection with the rotation of earth--make it impossible to state whether events in outer space took place in an area above a certain state. But even if outer space could be regarded as a territory with determinable borders, there is no assurance, as Prof. LISSITZYN has already correctly pointed out, 'that anything comparable to effective control over a part of the terrestrial surface can be established in outer space.' The rights of sovereignty cannot, therefore, in my opinion, be realized in outer space.
Author
International Cooperation; Laws; Space Exploration; Space Law

20050186945 United Nations, New York, NY, USA
The Report of the United Nations Legal Committee on the Peaceful Uses of Outer Space: A Provisional Appraisal
Feldman, George J.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 19-23; In English; See also 20050186936; Copyright; Avail: Other Sources

Although the report recognizes that the United l_ations Charter is not limited to the earth, some committee members would certainly not agree with this statement as to all the provisions of the charter. Specifically, the representative of Mexico described article 51, relating to self-defense, as a 'transitory' provision and not applicable to events in outer space [7]. I take issue on this point. Surely, the right of self-defense does not depend on the United Nations Charter; and, surely, it would be just as valid in outer space as on the earth's surface. There is ample and ancient authority in general international law for nations to take any necessary steps to protect themselves. Secondly, the report states that 'a comprehensive code of space law is not practicable or desirable' at the present time. I agree with this statement if the word 'code' refers to a body of detailed and rigid rules, but not if it means the drafting of a legal framework or the outlining of a legal system. The beginning of space law may be skeletal; they may be unilateral; they may even be nongovernmental, like certain unofficial codes of safety standards. In any case, the important thing is to begin now--to conduct research, hold discussions, and work out a basic framework of space law subject to later elaboration as we learn more about the space environment and space activities. The danger is not so much that space law may be formulated prematurely as that it may not be formulated in time. Accordingly, I would reverse the statement made in the committee report. Instead of saying that a code of space law is not practicable or desirable, although there is a need for action, as the report now does, I would prefer to say this: although an immediate comprehensive codification of space law may not be necessary or desirable, the committee recognizes the need for timely, constructive action. The difference is mainly a matter of emphasis, but it is an important difference nonetheless.
Author
International Law; Space Law; Aerospace Environments; United Nations

20050186948 Committee on Aeronautical and Space Sciences (U.S. Senate), Washington, DC, USA
The United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space: Accomplishments and Implications for Legal Problems
Galloway, Eilene; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 30-41; In English; See also 20050186936; Copyright; Avail: Other Sources

Since the :International Astronautical Federation held its first colloquium on the law of outer space at The Hague in 1958, historic steps have been taken by the United Nations toward the objective of an orderly development of the international forces released by the space age. It is important to include an account of these recent U.N. activities in the proceedings of the second space law colloquium because of their significance both to the IAF as an organization and to its members as individuals. That the talents of lawyers and scientists should be brought to bear simultaneously upon the problems of outer space was recognized by the United Nations in its first organized approach to this subject. The work was facilitated by the solid background of analysis which the international legal and scientific professions had furnished through the years. The foresight revealed in the

studies on space law which wer e published during the decade prior to the launching of the first earth satellite meant that future courses of action could be charted with much greater assurance than would otherwise have been possible. Close coordination between scientists and lawyers enabled the working committees of the United Nations to estimate the probable consequences of successful space exploration for mankind as a whole. The need for foresighted thinking directed toward the rational solution of space age problems will continue to be a challenge to individuals and organizations during a period of rapid scientific and technological progress. Laws, treaties, and conventions could restrict or encourage space projects. Unregulated activities could ultimately defeat their own ends in vital segments of space activities, e.g., in the use of radio frequencies for obtaining satellite data. The protection of the common interest of mankind in space activities will require continuous and harmonious working relationships between the professions of science and law. If we are to make a maximum contribution toward the solution of these problems during the forthcoming year, we must know what progress has been made thus far; what questions require study and analysis on a priority basis; and how we can work effectively through official and recognized nongovernmental organizations to achieve the benefits of international cooperation.
Author
International Cooperation; International Law; Space Exploration; Space Law; United Nations

20050186949 Leiden Univ., Netherlands
The Question of Freedom of Innocent Passage of Space Vehicles of one State through the Space above the Territory of another State which is not Outer Space
Goedhuis, D.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 42-43; In English; See also 20050186936; Copyright; Avail: Other Sources

1. As you undoubtedly are aware, the last General Assembly of the United Nations adopted on December 13, 1958 a Resolution to establish an Ad Hoe Committee on the Peaceful Uses of Outer Space, and requested it to report to the next General Assembly, i.a. on the nature of legal problems which may arise in the carrying out of programmes to explore outer space. In consequence of this mandate a Legal Committee was instituted which on June 12, 1959 accepted a Report to be considered by the General Assembly of the United Nations to be held from September to December, 1959. This Report has already rightly received a number of favourable comments but, since it still has to be considered by the United Nations, it obviously is not within the province of the Colloquium to pronounce an opinion on the many interesting'points it raises. 2. There is, however, one point that will necessarily arise in any discussion on the nature of the legal problems connected with the exploration and use of outer space to which the Colloquium could give some attention. The International Astronautical Federation, like the International Law Association, is no doubt of opinion that outer space constitutes common property of mankind open to use by all and not subject to appropriation by any one State. I believe it is right to say that the idea that outer space is 'res communis' and therefore, like the high seas, incapable of being appropriated by any State, is receiving growing support among States. I also believe it is right to say that the USA, who originally appeared to be inclined to consider outer space as 'res nullius,' are now prepared in principle to recognize space above a certain height as 'res communis.'
Author
Appropriations; International Law; United Nations; Space Exploration

20050186951 Canadian Astronautical Society, Montreal, Quebec, Canada
Some Rules Regulating Earth-to-Earth, Space-to-Earth and Earth-to-Space Missiles and Interplanetary Vehicles
Javitch, Ronald A.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 61-63; In English; See also 20050186936; Copyright; Avail: Other Sources

When a solution to an international agreement is arrived at, concerning 'vertical space boundaries' and laws regulating travel and transport in those regions, it will become necessary to create strict technical regulations regarding procedures of landing and starting high-velocity missiles and various other forms of vehicles of this nature. A concise although preliminary definition of three classes of transport systems will facilitate future nomenclature and descriptions, which may eventually be included in legal procedures: a) Earth.to-Earth Vehicle' - Any high-velocity 2 manned or unmanned transport-engine displacing itself from one point on the Earth's surface to another specific point designated as landing point.' b) Space-to.Earth Vehicle' - Any interplanetary manned or unmanned transport-engine displacing itself from any point in outer-space to a point within the Earth's atmosphere, be it a satellite-station landing point or a specific landing point on the Earth's surface.' c) Earth.to-Space- Vehicle_Any interplanetary manned or unmanned transport. engine displacing itself from a specific take-off point on the Earth's surface to any landing point in outer-space. ' The wording 'missile' will refer particularly to free-fall ballistic missiles, that is, those high-velocity vehicles not containing any engine or self-propulsion system. Generally, missiles and the other transport-engines (i.e., rockets and other forms of interplanetary engines) referred to in this text will not consist of war engines and thus shall not comprise the class of potential war-head carriers but will refer to normal transport vehicles.

The year 1960 will see extraordinary developments in all fields of astronautics, but particular ingenuity will be exposed in highly intelligent and mathematically accurate guiding, computing and telemetering systems, being in close coordination with navigation components which will be linked in turn with aerodynamic, or rather, astrodynamic controls.
Author
Agreements; Ballistic Missiles; Control Surfaces; Coordination; International Cooperation

20050186952 United Nations, New York, NY, USA
Space Exploration: Some Legal and Political Aspects
Lall, S. S.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 75-110; In English; See also 20050186936; Copyright; Avail: Other Sources

October 4, 1957 will go down in the annals of history as the day on which the dream of some of the greatest minds of the world became a reality. On that day, the first man-made 184 lb. earth satellite was launched in the Union of Soviet Socialist Republics, and mankind found itself a step forward in its escape from confinement to earth. Space travel, which had long been a matter of theoretical speculation or science fiction, became a reality overnight. The successful launching of an earth satellite was universally applauded. Prime Minister JAWAHARLAL NEHRU hailed it as 'a tremendous and magnificent achievement in the world of science.' This great scientific achievement also brought into focus some complex legal issues. Until October 3, 1957 the problem of the extent of national sovereignty in space was the concern of a relatively small number of jurist. Such questions as: where does national sovereignty in space begin; how far does it extend into the space above the surface of the earth; what laws should govern space flights, extra-terrestrial migration; radio channel allocation throughout a wide range of frequencies, etc., were merely of academic interest to the jurist. With earth satellites now actually circling the globe at 18,000 miles an hour, these problems have become real and urgent, and today there is a growing recognition of the seriousness and importance of the legal issues connected with the exploration of space. As we have at present no case or statutory space law, and all problems connected therewith are international in character, an international effort at the formulation of space law is urgently indicated if the potential dangers of extending the existing cold war into a 'hot war' are to be avoided. Some writers attach very great importance and urgency to the consideration of this problem. Professor John C. Cooper says that at the present stage, 'every day that passes with no attempt at real international discussion of the legal status of space beyond the air space and the legal status of the flight instruments using such space only adds to the chances for fatal international confusion and perhaps conflict'. A start has already been made in the recognition of the need for the study of space law by the International Civil Aviation Organization at its meeting held in Caracas, Venezuela, in June, 1956. But the problem is by no means an easy one and for that reason too, it needs greater attention without further delay.
Author
International Relations; International Law; Space Exploration; Space Law

20050186953 Canadian Astronautical Society, Montreal, Quebec, Canada
Proposals for the Future Work of the Permanent Legal Committee of the International Astronautical Federation
Pepin, Eugene; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 123-124; In English; See also 20050186936; Copyright; Avail: Other Sources

Last year, in Amsterdam, the International Astronautical Federation, after having expressed the view that 'the legal problems involved by the development of Astronautics be settled through a new international Convention', has created, on the proposal of the First Colloquium on the Law of Outer Space, within the framework of the Federation 'a permanent Legal Committee, open to lawyers of the various Societies or groups affiliated with the Federation, and whose members be entrusted with the study of all the problems of the law of space to be included in the above mentioned Convention.' The President of the Federation, Mr. A_D]aV.w G. HAL_.Y, acting as President of the Legal Committee, has established last April a list of members of the Committee; the list has been circulated. However, the Committee has not yet really started its work, although certain Astronautical Societies, like the American Rocket Society, has convened special meetings devoted to legal matters. It seems that one of the tasks of the London Colloquium should be the organization of the work of the Committee, i. e. the consideration and approval of its method and procedure. It is certainly difficult for more than 150 members of the Committee, who are in residence in many countries throughout the world and have generally various activities in addition to their interest in space law, to meet regularly and for a certain period of time. Even if such meetings would be possible, it would be difficult to achieve any concrete and successful study on such delicate matters with so large an attendance. The experience in other fields has proved that the best method for obtaining the best results is to subdivide the whole matter in a certain number of subjects and to entrust small groups (working groups or subcommittees) with the study of a particular subject. A membership of 6, 8 or 10, representing different systems of law, seems appropriate; the procedure of discussion would be by correspondence, with possible meetings, e. g. at the time of the annual Congresses of the Federation. A complementary method

would be the designation among the members of the group of a Rapporteur, who would prepare a report as a basis for the discussions. Naturally, any member of the full Committee might send contributions to the studies of each small group. Later on, some kind of coordinating committee would be established in order to centralize, under the supervision of the President, the report of the groups.
Author
Space Law; Conferences; International Cooperation

20050186954 Brazil Univ., Rio de Janeiro, Brazil
The Law of Interplanetary Space
Valladao, H.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 156-168; In English; See also 20050186936; Copyright; Avail: Other Sources

The juridical problems arising from the exploration, already initiated by Man, of the solar or interplanetary space, which we discussed in Brazil shortly after the launching of the first Sputnik, in October 1957 [1], and which had already been foreseen in previous works by other writers [2J--continued and continue to be the subject of careful studies by jurists and juridical associations of the principal nations of the world [3]. Taking our ideas to the first conference of jurists held after the great scientific event of this mid-century, in the opening session of the 10th Conference of the Inter-American Bar Association, in Buenos Aires, on November 14, 1957, we declared that it was the glorious mission of the Law: 'to protect Man from the arbitrariness of his fellow men, and, following evolution, to provide, for each new social, economical or technical discovery,a new juridical protection to the human being. No new power should be given to Man without immediate supervision by the Law.' Therefore, we concluded, 'in view of the present approaching of a Very New World, with the discovery of interplanetary world, with the utilization of the interplanetary space, we had to urgently require the creation of a Very New Law. At the threshold of a new era, the dawn of a New Law. Planning ahead in this matter, we said that 'an Interplanetary Law shall regulate the juridical problems of Interplanetary Space, problems which are already of today, and, later on in the future, a Jus inter genres astrorum, a Planetary 'Inter gentes' Law, shall determine, in view of the claimed contacts with other planets, the possible relations between the inhabitants of the various planets.' And we added that these very new laws 'must be inspired by an universal spirit, immune to the corrosive acid of national sovereignty and well above the predominance of countries, continents and planets, and above selfishness of individuals, groups, peoples or nations, because the World was given to Men by God, for them to enjoy it in peace, that is to say, with good will and altruism, loving and helping each other.' Hence, we proposed, and the Council and the Conference approved, the creation of a new and autonomous Committee, to deal with 'Legal Problems on Interplanetary Space', Resolution No. 49. It is the present Committee No. XVI, which met in Miami, U.S.A., from April 10th to 19th, 1959.
Author
Interplanetary Space; Law (Jurisprudence); Space Law; Personnel Management; Protection

20050186955 Committee on Science and Astronautics (U.S. House), Washington, DC, USA
Space and Cogno-Politics: A Third Force in World Affairs
Yeager, Philip B.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 169-176; In English; See also 20050186936; Copyright; Avail: Other Sources

The idea of going into Space has drawn a paradoxical pattern across the human mind. Up to now, at least, most of us have been caught up in the glamorous wonder of it while, at the same time, we have been shivering at the thought of some Spacecapable enemy attacking and obliterating us through this vast medium. These conflicting reactions have been so starkly delineated that one would almost think them the only channels through which to approach the basic meaning of Space exploration. Popular attention has focused, on the one hand, upon the magnificence of rocket hardware, the genius of instrumentation, the discovery of new truths and universal laws--with all that such things mean for our technology and physical modes of living. On the other hand, our attention has been equally gripped by the threat of the ICBM, the military Space station, or maybe a death-ray directed from an orbiting vehicle--with all that these possibilities conjure up in the fearful planes of our subconscious. In other words, Space seems to be selling us on either a rapturous hope for a better life through technical innovations, or a black anticipation of eventual war and chaotic destruction. Somewhat outside these extremes, of course, lies the pristine interest of the scientist who wants to know for the sake of knowing and, through Space exploration, is finding out. While this is a major factor in any long-range view of the future, it is not an important part of the theme here. This inquiry is concerned with the meaning which Space investigation may hold for the practical relationships of men, and I suggest that any national capacities for such investigation which are truly advanced, especially demonstrated capacities, will have a crucial effect on future world politics and on the subsequent development of international law in ways fundamentally unrelated either to standards of living or to physical ruin. That effect will result from the introduction of a pair of new

quantities into the equation of international affairs. These are knowledge and understanding, in that order, and they will evolve mainly through our efforts to learn about Space. They are quantities synonymous with a newly-developing art which might appropriately be termed cognopolitics2--a discipline even now showing on the horizon as a Third Force in Earth's political history.
Author
Space Exploration; Politics; International Law; Intercontinental Ballistic Missiles; Space Stations

20050186956 Smirnoff (Michel S.), Belgrade, Yugoslavia
The Role of IAF. in the Elaboration of the Norms of Future Space Law
Smirnoff, Michel S.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960]; In English; See also 20050186936; Copyright; Avail: Other Sources

Just one year ago we met in the wonderful atmosphere of Rolzaal in Binnenhof at The Hague and decided to create a Legal Permanent Committee which would be entrusted with the study of all problems of the law of space. We decided also that all these legal problems have to be settled through the new International Convention on Space Law Problems. And we decided to cooperate with the United Nations in all their initiatives in this field s . Since then one year has passed and we can make an account of what has been done in this respect in the past year. First of all we must state that this year has seen the continuation of the technical efforts in the field of astronautics. We all know that in this year very important results were reached and both Soviet and American rockets have accomplished their first trips in the direction of the Moon. Many new satellites and rockets have been sent with instruments and even with animals to outer space and many animals returned to the earth after this great experience of a travel in the space. The time is approaching when a manned rocket will start on the first cosmic excursion. Therefore, the need for a solution of numerous legal problems which arise with the space flights is still imminent and even more imminent than it was last year when we agreed in The Hague on the need of a settlement of those problems through a new international Convention. Let us see now where we are in respect to the initiatives in this field. We shall begin our analysis with a short apercu of what has been done in this respect in an organisation which we mentioned in our Resolution of last year--I mean in the United Nations. As you all know, by a Resolution of General Assembly on 12 December 1958 an ad hoc Committee on the peaceful uses of outer space was created. This Resolution was adopted by 53 votes to 9 with 19 abstensions. The Resolution said that the following 18 States should be the members of that ad hoc Committee: Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, india, iran, italy, Japan, Mexico, Poland, Sweden, the Union of Soviet Socialist Republics, the United Arab Republic, the UK of Great Britain and Northern Ireland, the USA of America. This Resolution was carried out after a Soviet draft resolution of November 7 [1], binding the question of the banning of the use of cosmic space for military purposes with the problem of the elimination of foreign military bases on the territories of other countries, had been rejected.
Author
Space Law; Interstellar Space; International Law; United Nations

20050186957 Paris Univ., France
The Functional Regulation of the Extra-Atmospheric Space
Seara-Vazquez, Modesto; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 139-146; In English; See also 20050186936; Copyright; Avail: Other Sources

In order to determine the juridical nature of the space, we must, first of all, identify it, define it. But to identify a thing we must delimit it. However, we cannot find a basis for delimiting the space. In fact, where does it begin and where does it end ? These are questions which we cannot answer. We should not consider the space as a delimited thing, for it is not contained but a content z. The space is not placed within the frame of the totality, beside other parts to which it could be brought into relation. The space is the totality in which the parts are placed. The space can be defined only in a negative way: that which is not limited. A negative definition, however, is only an implicit recognition of incapacity. This should be frankly admitted. We could attempt, on the other hand, a delimitation of the space or, to be more exact, of part of the space, with regard to the earth or any other fixed point. However, the earth is in continual movement and so is the solar system. Even the galaxy is moving. For this reason, all the delimitations which might be established would be established with regard to fixed points which, paradoxically, are moving at fantastic speeds. Even if we speak of points considered fixed, a delimitation founded on relative bases would be impossible, taking into consideration the continual change of relation in the space. Therefore a definition of the space seems to be impossible. This impossibility originates from the incapacity of human comprehension, not only for delimiting the space but even for forming a conception of it, for EINSTEIN'S conception of the space as a curved being does not seem to be very clear and, much less, simple. If we finally admit the necessity to consider that the space cannot be defined, either with regard to the object or with regard to the phenomenon, we arrive at the conclusion that the space cannot

be per se the object of a law on the part of the states s, either singularized or integrated into the Community of Nations, because the space, which would constitute a territory, in the legal sense of limits subjects to the sovereignty, could not be delimited and we would find ourselves
Author
Galaxies; Space Law

20050186958 International Astronautical Federation, Washington, DC, USA
Proceedings of the First Colloquium on the Law of Outer Space
Haley, Andrew G., Editor; Heinrich, Welf, Editor; [1959]; 135 pp.; In English; First Colloquium on the Law of Outer Space, 1958, The Hague, Netherlands; See also 20050186959 - 20050186983; Copyright; Avail: Other Sources

The concept of the International Astronautical Federation Colloquium on Space Law evolved from conversations between the undersigned during the course of a lecture tour of American Universities which we undertook in the Fall of 1957, and at subsequent meetings in Europe. Lectures on 'The Law of Outer Space' were given at the Universities of Princeton, Detroit, Chicago, Michigan, Northwestern, Wisconsin, Minnesota, Montana, Montana State, Gonzaga, Washington, California (Berkeley), California (UCLA), Utah, Colorado, St. Louis, Washington (St. Louis), Harvard, Georgetown, American, Maryland, arid so on; and in Europe by one or the other of your editors at th_Universities of Paris, Stockholm, Copenhagen, Berlin, Munich, Stuttgart, Madrid, Lisbon, Belgrade, Prague, Warsaw, Moscow, Leningrad, The Evangelical Academy at Loecum, and so on; and before numerous learned societies and many technical institutes and groups. The attendance at these lectures pointed up the profound interest of world-renowned teachers and practicing jurists, on the one hand; and thousands of students and members of the public, on the other hand, in the subject of the law of outer space. The intimate importance of space jurisprudence to thinking men, arid especially experts in the social sciences, was demu_L_ated beyoi_d question. Throughout the world there are many local committees and local centers of learning supporting space law studies and investigations--but there was no concerted international effort devoted to this subject as a special effort of mankind. We decided to call the First Colloquium on Space Law and it was obvious that one of the most appropriate centers in the world would be the Rolzaal, in The Hague, a birthplace of human fights and a city rich in the tradition of international arbitration and adjudication--and indeed the world center of such activities. As will be seen from this volume of Proceedings, the First Colloquium was well attended and many excellent papers were presented. During the course of the Colloquium the participants voted to establish a Permanent Legal Committee of the International Astronautical Federation--an action which was later ratified by the Council of the Federation. In cooperation with the Member Societies of the International Astronautical Federation there has been assembled the Permanent Legal Committee, which comprises many leading jurists and social scientists from an parts of the world. The current membership of this Committee appears as an appendix to these Proceedings.
Author
Space Law; Conferences; Human Beings

20050186959 McGill Univ., Montreal, Quebec, Canada
Observations
Pepin, Eugene; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 91-92; In English; See also 20050186958; Copyright; Avail: Other Sources

First of all I wish to congratulate the President of the International Astronautical Federation, Mr. A. G. H_Y, for convening this First Colloquium on the Law of Space; the large attendance not only of lawyers but also of scientists demonstrates the general interest by the Law of Space. I am in complete agreement with the remarks made by the presiding speaker of the panel. The necessity for further studies of the legal problems deriving from the progress in astronautics becomes every day more evident. Such studies should necessarily be conducted on a real international basis and the Federation seems to me the best medium to permit close cooperation between lawyers and scientists. Therefore, as the so called 'Committee CooPeR' established in Barcelona by the preceding Congress never met and has now disappeared as a result of the resignation of its chairman, I propose that a new Committee, but a permanent one, be established in the framework of the Federation and open to lawyers of all astronautical societies in the world. Such a Committee would examine any legal problem the solution of which might be devised by an international convention, as all the speakers agreed on the neee._it.y of such a Convention. As the space problems are also under consideration in the United Nations the President of our Federation would certainly notify the Secretary of the United Nations of the establishment of a Permanent Legal Committee of the Federation.
Author
Conventions; Progress; Space Law

20050186960 Heidelberg Univ., Heidelberg, Germany

Introduction: A Light from the Past to Show Up the Legal Problems of Our Age of Space

vonRauchhaupt, W.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 1-4; In English; See also 20050186958; Copyright; Avail: Other Sources

In company with so many others, the International Astronautical Federation at their recent congress at Amsterdam, and the Grotius-Stiftung in Munich, Germany, with branches in 20 countries, are all moving in parallel directions for the same purpose of furthering mankind and to give us the new International Law we now need. At the 10th Anniversary Festival Session of the Grotius-Stiftung, President ANDREW G. HALEY and WELF HEINRICH PRINCE of HANOVER gave lectures on air space and space law, and Professor E. A. KOROVIN sent a paper on the conquest of the stratosphere and Public International Law. The most important factors are the moral values which are reliable milestones toward World Peace and Order.

Derived from text

International Law; Space Law; Airspace; Public Law

20050186961 International Astronautical Federation, Unknown

Space Age Presents Immediate Legal Problems

Haley, Andrew G.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 5-27; In English; See also 20050186958; Copyright; Avail: Other Sources

What are some of the immediate legal problems ? 1. Within the framework of the pertinent international treaties, lawful use must be made of radio frequencies for all forms of astronautical communications. This requirement of international law has been observed only once by any nation since the launching of Sputnik I. I venture to say that as time goes on the international obligations of the nations of the world will be more and more ignored--if the lawyer does not intervene and make himself heard in the United Nations and in the International Telecommunication Union. Many radio frequencies are needed for communication between Earth and vehicles in space, and between vehicles in space and Earth; between Earth and positions in space, and positions in space and Earth; and so on.

Author

International Law; Radio Frequencies; Telecommunication

20050186962 Cooper (John Cobb), Princeton, NJ, USA

The Problem of a Definition of 'Air Space'

Cooper, John Cobb; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 38-44; In English; See also 20050186958; Copyright; Avail: Other Sources

At the Barcelona Conference of the IAF in 1957, a proposal was made by the present distinguished President of the Conference, Mr. A. G. HALEr, that a committee be named to prepare a definition of what is meant by the term 'air space', as used in connection with flight of aircraft and other instruments. The conference honored me with appointment as Chairman of the proposed committee of scientists and jurists. Difficulties arose in connection with the completion of the membership as originally envisaged. This fact, as well as certain personal considerations, impelled me to submit my resignation. The problem however still exists. For that reason this memorandum has been prepared in the hope that it may be of some value in any future consideration of the basic problem.

Author

International Law; Space Law

20050186963 French Astronautical Society, Paris, France

Comments

Homburg, Robert; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 79-81; In English; See also 20050186958; Copyright; Avail: Other Sources

The conquest and utilization of space beyond the limits of the atmosphere have ceased to belong to the field of fiction and have become realities. Whether regarded from a scientific or legal point of view, the stage of purely theoretical discussions has, to a large extent, been passed. Technical progress, too, today provides jurists with sufficiently important and numerous data for them to begin laying the foundations of Space Law. One may well ponder on the construction of such a law: An International Convention regulating Astral-Navigation (Astronautics); A Universal Union for the utilization of inter-sidereal

space etc. But whatever the final decision may be, it is quite certain that there will be no worthwhile and stable foundations unless a detailed blue-print is first drawn up by competent architects.
Author
Space Law; Personnel; Space Navigation

20050186964 Rivoire (Jean), Paris, France
The Hellenic Contribution in Astronautics
Rivoire, Jean; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 96-101; In English; See also 20050186958; Copyright; Avail: Other Sources

In my capacity as President of the Hellenic Astronautical Society I would like to avail myself of this opportunity to express my thanks for the admission of our Society as a Member of the International Astronautical Federation. Greece being a small country, her contribution in astronautics is necessarily limited. However, our interest in the subject is beyond any doubt. Space Law is of considerable importance, and international agreement under the auspices of the United Nations Organization is highly desirable. Our lawyers must co-operate in promoting this new and original problem facing their profession, side by side with our professional and amateur astronomers who are invited to exploit the proverbial clarity of the Hellenic sky and to offer their own contribution in the exploration of outer space.
Author
United Nations; Space Law; International Cooperation

20050186966 Heinrich (Welf), Hanover, Germany
Problems in Establishing a Legal Boundary between Air Space and Space
Heinrich, Welf; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 28-30; In English; See also 20050186958; Copyright; Avail: Other Sources

The problems with which we are faced today resemble in some respect those which arose at the turn of the century, when powered flight seemed to be a real possibility for the first time. At that time, man's practical experience of aviation was confined to balloon flights, and so the problem of the consequences resulting from the realization of such aeronautical ambition_ was largely a theoretical one. Some experts, for example, argued that the air was everywhere just as free as the high seas, while others maintained that it was subject to the sovereignty of the states beneath it. In the meantime, technical progress had outstripped international law. The flight of aeroplanes had become a fact, and governments now had to face the practical consequences, even though they had not agreed upon any guiding principles as yet. Before World War I, Britain and Russia had already made it a condition that permission must be obtained for flights into the air space above their territories, and in the course of the war all states came to regard such incursions as breaches of sovereignty. It was not until 1919 that the mutual recognition of the absolute sovereignty of a state over the atmosphere above it was formally embodied in an international agreement. This agreement, signed in Paris, was later confirmed in the same terms under the Chicago Convention in 1944, which still regulates international aviation. Today we are again faced with a situation in which accepted international law seems likely to prove inadequate to cope with the circumstances. Space flight is now an accomplished fact, and the Chicago Convention was designed to cover only the atmosphere, and does not define how far this zone extends. The underlaying assumption, though not directly expressed, is that national sovereignty, as on the high seas, extends as far as a state can exercise effective control from its own territory, and, until recently, this in turn meant within the range of anti-aircraft artillery. With the advent of rockets capable of being fired to heights of several hundred miles, and the launching of earth-satellites, one can ask whether an attempt to apply this principle further would not lead to absurd consequences. I need only mention one of them : the fact that the earth, together with the rest of the universe, is in constant motion, and the boundaries of a country's territorial jurisdiction, ff they were to be extended vertically to an indefinite height, would therefore be changing every moment. The untenability of such a proposition is at once clear, particularly if one envisages the possibility--which some think is not so remote--of firing rockets to the moon.
Author
International Law; Space Law; Agreements; Airspace; International Cooperation; Governments; Sovereignty

20050186967 Alessandrone-Gambardella (V.), Rome, Italy
Contribution
Alessandrone-Gambardella, V.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 31-32; In English; See also 20050186958; Copyright; Avail: Other Sources

I have followed with attention and interest the speeches of the eminent jurists who have spoken before me. Although I

share to a great extent the opinion of Mr. Smirnoff, who is one of the official speakers of the Colloquium, I should like to add a few remarks concerning those points in his so very lucidly expounded conception with which I disagree, if only to a very modest extent. My point of disagreement in no way concerns an eventual criticism of the theory by which sovereignty over territorial air space can be defined by dividing it into an 'atmospheric' and an 'extra-atmospheric' space, and into a number of layers graded according to their height, as though space was a material and readily grasped object, like a piece of fruit or a loaf of bread which can be carved up into slices: slices which would multiply in number, at any rate with regard to their descriptions, as time goes on--a kind of repetition of the miracle of Canaan... It is generally known that such a conception, from the theoretical and even more so from the practical point of view, has been proved to be almost impossible to substantiate, either because the ceiling of sovereignty would be far too high, or simply because such a demarcation line doesn't exist at all. The other theory does not deserve any consideration either. This theory maintains that it is sufficient in order to solve the 'vexata quaestio' of sovereignty to rely on the sanctified principles of the law of the High Seas and to apply by analogy the terms which differentiate between 'territorial waters' and 'extraterritorial waters'. The mistake behind such an application to air law can be easily found in the Italian Navigation Codex [1] which, way back in 1942, extended the principles of the maritime law to air law. Even worse, in our opinion, would be such an application to the sphere of space law which we are in the process of formulating.
Author
Airspace; Space Law; Sovereignty; Air Law; Sea Law; Formulations

20050186968 Sociedade Interplanetaria Brasileira, Sao Paulo, Brazil
A Contribution to the Problem of Space Law Establishing a Technical and Practical Limit to Political Sovereignty in Space
deGonzagaBevilacqua, Luiz; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 33; In English; See also 20050186958; Copyright; Avail: Other Sources

A considerable number of authorities are now concerned in preparing rules as a basis for limiting national sovereignty in space. The altitude limit, however, seems generally to be expressed in terms which are neither technical nor practical. Here is a tentative proposal for a precise, yet at the same time a natural limitation of sovereignty regarding altitude : It is suggested that the criterion should be the nature of the craft involved, namely that the altitude at which sovereignty pertains should be linked to the altitude at which the craft remains dependent on the atmosphere. If this definition seems to be acceptable, then the ceiling of jet-propelled planes will mark the limit of national boundaries in space; rockets, therefore, will be free to operate above this ceiling in 'free space'. Means of propulsion of the future, by the above definition, will automatically fall into one category or the other, allowing, perhaps, for a slight modification of the present 'ceiling'---deep space, however, will remain definitely free of any claims to national sovereignty.
Author
Space Law; Sovereignty; Altitude Control

20050186969 Argentine Interplanetary Association, Argentina
Principles for a Declaration with Reference to the Legal Nature of the Moon
Cocca, Aldo Armando; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 34-37; In English; See also 20050186958; Copyright; Avail: Other Sources

In contrast to past methods of procedure, law today must anticipate the technical progress, and foresee the legal implications. The consequences which follow from fait accompli cannot be permitted in the present stage of the development of civilization. The jurist is faced with this duty, as has been pointed out in the publications by CONSTANTIN A. STAVROPOULOS, head of the United Nations Legal Department, when he referred to the legal problems of space exploited by artificial satellites. The duty of the legal profession is to work out the general principles which may serve as a basis for the future regulation in the use of space and the planets. In view of the fact that the immediate objective of astronautics is to reach the Moon, we consider that it might be useful to anticipate a few concepts in order to draw up a final draft declaration regarding the legal nature of the earth's natural satellite. To this end, the proposal should be divided into three parts : I. Prior considerations to be discarded from a legal point o/view (Our intention is thus to facilitate the work of others who are either co-operating with us or who will follow in our footsteps); II. Legal possibilities and recommended principles (This section is intended to anticipate the results of our initial thoughts on this problem in seeking a workable solution); III. Draft Declaration (This will be a summary of previous work and a material contribution to the preparation of Interplanetary Law).
Author
Space Law; Interplanetary Spacecraft; United Nations; Moon; Planets

20050186971 Select Committee on Astronautics and Space Exploration, Washington, DC, USA

An American View of Jurisdiction in Outer Space

Feldman, George J.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 45-50; In English; See also 20050186958; Copyright; Avail: Other Sources

In addressing an international audience such as this, it is probably best to begin with the situation in my own country, including proposals and prospects for change. The USA has recently enacted what I believe to be the world's first statute dealing with astronautics. The National Aeronautics and Space Act [1], signed by President E_sE_rHOWV.R on July 29, 1958, creates a new agency of government to be known as the National Aeronautics and Space Administration. In addition to planning and conducting both aeronautical and space activities, the new agency is directed to arrange for scientific observations and measurements, like those of the International Geophysical Year, and to promote the spread of scientific knowledge relating to outer space. Top policy and overall coordination will he provided by the President himself, with the advice of the National Aeronautics and Space Council, over which he will preside, and which will consist of high-level government officials and distinguished private citizens. The new agency is authorized to engage in a program of international cooperation, in the interest of scientific progress and world peace. The Act declares it to be the policy of the USA that activities in outer space shall be devoted to 'peaceful purposes for the benefit of all mankind'. Although the National Aeronautics and Space Administration is not given regulatory powers, the appropriate committees of Congress contemplated that it would conduct legal and related research with a view to domestic legislation and regulation as well as international agreements governing the use of outer space. Witnesses before the House Committee agreed that the legal regime of outer space would be the 'primary' problem confronting the new space agency [2]. At any rate, it seems clear that space law must be developed in order to prevent anarchy in the use of outer space. The problem is grave and urgent because of the military potentialities of missiles, satellites, and space vehicles. Even outside the Government, space law is being widely discussed in the USA. For example, the American Bar Association has established a special committee on the subject, and has devoted to it a considerable part of the program at the annual Association meeting at Los Angeles. What is the nature of the legal problem which the new space agency will meet in considering the international control of outer space ? Flight through outer space is not expressly governed by international law. The only generally accepted international flight agreement is the Chicago Convention on International Civil Aviation (1944), to which the USA, though not the Soviet Union, is a party.

Author

Law (Jurisprudence); International Law; Space Law; Policies; Agreements; Coordination; International Cooperation

20050186972 Select Committee on Astronautics and Space Exploration, Washington, DC, USA

A Definitive Study of the Concept and Scientific Strategy of Outer Space: The Challenge to all Nations to Support a Just System of Space Law

Fulton, James G.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 51-58; In English; See also 20050186958; Copyright; Avail: Other Sources

The ocean of space has first opened in the year 1957, and the people of our generation in the whole world now look out from our safe harbours and the vast reaches of the earth, the sea and the atmosphere, to the tremendous challenge of the limitless ocean of outer space. Our preconditioned reflexes and our minds educated for earth problems are confronted with the necessity of developing a legal and scientific philosophy to approach and open up the fields of knowledge in this incredible ocean that engulfs all of us. SCHOPENHAUER has stated the historical philosopher's approach to the world as follows : 'The world is my idea--this is a truth that holds good for everything that lives and knows, no man alone can bring it into consciousness .... ' As in SCHOPENHOUER'S days the science of the earth was unknown, in our days the law and science of outer space have not been born. SCHOPENHAUER pointed out that-- Knowledge as a rule then remained always subordinate to the service of the human will, as he felt knowledge indeed originated for this service. Our world legal systems are based on control and sovereignty. We world people must face knowledge and space that can never be subordinate to the human will, and we can't foretell of what service, ff any, the knowledge might turn out to be. There are no philosophical anchors, signboards for scientists, legal traffic signs, or sidewalks for amateurs in outer space. At present space is a lawless country. SCHOPENHAUER SO clearly saw thaf_-- 'The transition ... from the common knowledge of particular things to the knowledge of the idea, takes place suddenly...' This took place for 'Space' with dramatic effect on October 4, 1957, when the first orbiting sputnik roused the entire world. Every person knew the idea of a successful orbit changed his world and scared him for the security of his future. Each person found he was suddenly part of space, as BYRON said--- 'Are not the mountains, waves, and skies a part of me and of my soul, as I of them.' Thus, BYROI_ like PLATO draws nature into himself so that he sees it as an accident of his own human being. But we now know space is more than any of our forebears thought, philosophers or not. Space and the heavenly bodies do 1 Member of Congress for Pennsylvania, Member House Foreign

Affairs Committee, Member Select Committee on Astronautics and Space Exploration, U.S. House of Representatives, Washington, D. C., U.S.A. 4*
Author
Earth Atmosphere; Security; Sovereignty; Space Exploration; Space Law

20050186974 Committee on Aeronautical and Space Sciences (U.S. Senate), Washington, DC, USA
The Community of Law and Science
Galloway, Eilene; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 59-62; In English; See also 20050186958; Copyright; Avail: Other Sources

Space may be illimitable but the amount of space man can control by scientific invention and by rules and regulations has limitations. The perimeters of our limitations will change with the development of scientific facts and with our ability to control these facts in their impact upon society. In 1886, Mr. Justice HOLMES counseled that 'All that life offers any man from which to start his thinking or his striving is a fact... For every fact leads to every other by the path of the air. Only men do not yet see how, always. And your business as thinkers is to make plainer the way from some thing to the whole of things; to show the rational connection between your fact and the frame of the universe... To be master of any branch of knowledge, you must master those which lie next to it; and thus to know anything you must know all.' [1]. Since the time when our great Justice advised students of the law to become complete in all their powers, the pursuit of knowledge has become so specialized that our thinking is endangered from confinement within compartments. Increased specialization is not only necessary but inevitable as scientific experiments require deeper penetration into detail, but without a concomitant development of the interaction of related fields of knowledge, we shall lack wisdom in controlling general problems which affect the destiny of all mankind. It is a large order to expect any man or group of men to consolidate theory and practice in the new dimension created by space exploration; but unless we start with a total objective and a concept of how it is to be pursued, our interplanetary thinking will be earthbound by tradition and precedent at a time when creative predictions should enable us to keep international law in pace with scientific achievement. Together, these professions have the same objective--the creation of conditions which will promote the general welfare and protect the people in their 'right to life, liberty, and the pursuit of happiness.' Both science and law must start with an evaluation of existing facts and with assumptions concerning the foreseeable future. The revolution in science and technology imposes an obligation on the scientific community to keep the legal profession informed of the latest developments. National and international lawyers have the matching responsibility of absorbing new facts into the framework of social order.
Author
International Law; Technologies; Space Exploration; Group Theory; Inventions

20050186976 Sociedade Interplanetaria Brasileira, Sao Paulo, Brazil
The Internationalization of Outer Space and the Unification of World Astronautical Strategy; the Ecumenical Nature of Astronautics
Pereira, Flavio A.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 93-95; In English; See also 20050186958; Copyright; Avail: Other Sources

Astronautics is one of a number of technological developments of the present age. As a scientific, economic and political force, it must be considered as the greatest human (or ecumenic) activity open to all nations, regardless of their size, importance, or international political status. From the philosophical point of view, Astronautics represents the final period in the development of the Ecumene, or Human Biosphere, so that the entire history of mankind may be considered as a veritable ecumenization of the Cosmos. We must look upon world evolution in technology in this sense. Astronautics also ratifies the psychological or 'spiritual' unity of humanity, through which it must be transformed into an instrument worthy of this dignity. This ecumenization of the Cosmos began on our planet a thousand years ago, and soon it will be extended to adjacent heavenly bodies, beginning with the Moon. Venus and Mars, ecospherical planets in the STRUGHOLD terminology, will be ecumenized after the Moon. We must define the Ecumenization of the Solar System, not only in the sense of its empirical or practical dimensions, but also as a juridical and cultural problem. That is to say that the penetration of human activities into outer space by means of cibernetical vehicles, or manned spaceships, will lead to far-reaching philosophical and anthropological modifications in the existing international political structure. For Astronautics, historically speaking one of the final scientific revolutions, will concern heights which have never been reached since the egocentric conception of the world was replaced by the geocentric, by the heliocentric, and finally by the galactocentric conception.
Author
Terminology; International Law; Space Law; Economics

20050186977 Utrecht Univ., Utrecht, Netherlands

Design for a Law of Space

deRode-Verschoor, I. H.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 103-104; In English; See also 20050186958; Copyright; Avail: Other Sources

The government of the USA encountered no objection when, in 1955, it announced its intention of launching artificial satellites of the earth as a contribution to the International Geophysical Year. Later, the Soviet Union announced a similar plan without evoking any reaction either. Public opinion at that time regarded these projects with scepticism, ff not with indifference. The situation changed radically at the end of 1957 and at the beginning of 1958 when the first satellites began circling around the earth, and when they became the focal point of fierce international competition. General admiration for these achievements became tempered with a feeling of uneasiness which, unfortunately, could not be removed by claims of justification. At the present time, some of the information collected by means of satellites may indeed be of strategic value. Eventually, when the problem of reentering the lower atmosphere has been solved, it will be possible to transport thermo-nuclear charges into space by means of satellites, and to direct them back to earth at a chosen time and place, the attack being controlled by radioelectric means. Under such conditions, satellites launched into space constitute permanent potential bases of aggression secure from counter-attack. It is therefore hardly surprising theft some countries, aware of these disquieting facts, object to foreign artificial satellites being allowed to fly over their territories. However, in my opinion, this attitude is erroneous for a number of reasons based on both the facts and the law. The fact that a satellite did not move above a given country would by no means ensure security. If any of these artificial bodies returned to earth out of control either as a whole unit or in pieces, it would certainly not follow its normal trajectory in falling. Depending on its initial altitude and velocity, it might hit any point on the terrestrial globe. Is any country legally entitled to forbid the passage of an artificial satellite over its territory ? Nothing is less certain. In October 1957, a Soviet jurist stated that it is not the satellite which penetrates the space area of certain countries, but rather that it are the space areas of these countries which put themselves temporarily within the orbit of the satellite in consequence of the rotation of the earth [1]. This is not only an original idea, but something which should be given some thought. Certain habits in thinking and judging which we have acquired on this earth are not applicable in an extra-terrestrial world. In penetrating new areas of space, astronautics confronts us with fresh problems.

Author

Artificial Satellites; International Geophysical Year; Satellite Rotation; Law (Jurisprudence); Space Bases

20050186978 Gatland (Kenneth W.), Twickenham, UK

Contribution

Gatland, Kenneth W.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 63-65; In English; See also 20050186958; Copyright; Avail: Other Sources

I can only speak from the standpoint of the engineer, for I am certainly no expert in the fine art of law--international or otherwise. But, nevertheless, I feel most strongly that scientists and engineers share an equal responsibility with the law-makers and should play their part in helping to shape the social sciences which, in this present age, are lagging so badly. In astronautical development we have a unique opportunity, for we can already see the shape of future events emerging in this fast growing science and have the opportunity of planning certain rules of conduct accordingly before the events themselves occur. Needless to say, we cannot at this stage consider enforcement of a law of outer space, but we can, and should, draw attention to the need for an international code of behaviour both in the interests of humanity and the future of scientific exploration; this should be discussed at the highest international level. The IAF Committee on Space-Law, which met earlier this week in Amsterdam, has suggested a number of points as requiring urgent attention. These are: (a) upper limit of effectiveness of present air law; (b) upper limit of national sovereignty; (c) radio frequency rules affecting artificial satellites and other space vehicles; (d) rules governing the re-entry of falling satellites; (e) rules affecting the operation of satellites for weather observation, radio and TV relays, and other public services; (f) quasi-military functions (e.g. reconnaissance satellites); (g) military conventions; (h) contamination of extra-terrestrial bodies; (i) rules of discovery and occupancy affecting extra-terrestrial bodies; and (j) deleterious effects caused by as yet unknown physical phenomena and techniques. Scientists are already thinking of mounting TV cameras in satellites for the purpose of obtaining an overall picture of the earth’s cloud cover and other meteorological phenomena (e.g. the movement of storm centres, etc.). Although this holds promise of revolutionizing the science of weather forecasting, such vehicles could be used to map foreign territories and carry out certain reconnaissance duties. This directly raises the question of national sovereignty, for despite the fact that no objection

has been raised to the passage of IG satellites over sovereign States, the situation would be markedly different if these vehicles carried reconnaissance equipment or were acting as bomb carriers.
Author (revised)
Air Law; International Law; Television Systems; Space Law

20050186979 Smirnoff (Michel S.), Belgrade, Yugoslavia
The Responsibility of States for the Damage Caused by Launched Space-Bodies
Smirnoff, Michel; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 105-109; In English; See also 20050186958; Copyright; Avail: Other Sources

One of the topics which may be discussed at an international conference may be the responsibility of states for possible damage caused by launched space-bodies. For it will be the states which will have to bear the responsibility, because, whereas air-navigation is carried out to a large extent by civil aircraft, in space navigation only state-owned spacecraft will be used for some time to come. In this respect we need only to consider the high cost of launching these spacecraft. The Chicago Convention can only be applied to civil aircraft. It will therefore be necessary to make an entirely new set of regulations for state-owned spacecraft. In formulating rules concerning this responsibility for damage, it will be necessary to register and identify the launched spacecraft and make provisions for a compulsory registration of space-satellites in order to determine the identity of the state to be held responsible. The basis for this onus of responsibility is clearly set down in Professor MEYER'S 'Verkehrssicherungspflicht' [1]. The professor states the principle, which is now widely familiar in all countries, that states have the duty of avoiding damage, because by creating a source of danger, this automatically incurs a responsibility to the community. Now in my opinion one can visualize three solutions regarding this responsibility: 1. That the state launching the spacecraft shall accept full responsibility for possible damage (comparative to the Rome Convention and the principle of risk). 2. That the state shall be entitled to make certain reservations, as, for instance, under the Warsaw Convention (principle of the liability of fault), excluding, for example, responsibility in the case of force majeure: for instance, an unforeseen collision with a meteor. 3. The setting up of an International Guaranty Fund to pay for damage caused by satellites (except in a case where damage is caused intentionally, in which case the state responsible would be liable to make compensation). Each state interested in astronautics would be required to contribute to the Fund. This third solution may be desirable, for in the future it may not be possible to insure against damage caused by earth-satellites in view of the enormous risks and uncertainty.
Author
Air Law; Air Navigation; Space Navigation; International Law; Regulations

20050186980 Bundesministerium fuer Verkehr, Bonn, Germany
Contribution
Gerlach, F.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 66-68; In English; See also 20050186958; Copyright; Avail: Other Sources

For many years, scientists of the various branches of natural science, as well as laymen who have been interested in the subject, have all been engaged in trying to bring about the realization of space travel. In most cases, these groups of people have formed national societies in their own countries in order to coordinate their efforts. These bodies, in turn, have joined together to establish the International Astronautical Federation under whose auspices the present Colloquium is taking place. While the first congresses of the IAF were devoted almost entirely to the study of physical and technical problems, and later on to the medical problems of space travel, space law has become---even though there has been a gap of some twenty years between the phases--a continuing subject of negotiation and discussion both inside and outside the IAF; the VIIth International Astronautical Congress, which took place at Rome in 1956, showed quite plainly that the problems of space law could only be solved by those lawyers who not only possessed the necessary competence, but also had a working knowledge of at least the basic principles of the technical and physical problems of space travel. Such basic knowledge should certainly not be taken for granted, as many statements made by jurists over the past years have shown all too clearly, but it is only by serious study that jurists who wish to contribute something of lasting importance towards the shaping of space law can become familiar with the technical fundamentals of jurisprudence in this sphere. About the year 1910, when the nations of the world set out to grapple with the new legal problems which were brought about by the arrival of the motorcar, they were confronted with a problem which involved technicalities experienced in everyday life. The situation is quite different in the case of the problems of space travel and therefore that of space law. In this case, it is impossible for the man in the street, and this means the average lawyer too, to grasp readily the technicalities involved. One hears often enough in legal circles the question as to how indeed a rocket can function at all in airless space, when the air which could support it just doesn't exist. And so it is vital that lawyers

should first of all familiarize themselves with the technical and physical preconditions for space travel before they are in a position to contribute something worthwhile to the solution of space law.
Author
Aeronautical Engineering; Space Law; Spheres; Circles (Geometry)

20050186981 Air Univ., Randolph AFB, TX, USA
The Need for a New System of Norms for Space Law and the Danger of Conflict with the Terms of the Chicago Convention
Strughold, Hubertus; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 110-113; In English; See also 20050186958; Copyright; Avail: Other Sources

In view of everything which has been said and written about space law in the USA, Canada, Europe and in other parts of the world, some points are now quite clear and, in theory, there is almost unanimous accord on the essential elements of the law of space. These basic principles are as follows: (1) It is commonly agreed that the system created by the Chicago Convention is not adequate to solve the problems of law presented by the advent of space flight. For many reasons, the terms of the Chicago Convention, which repeat the principles of the Paris Convention of 1919 concerning the sovereignty of States over the air space above their territory, cannot be applied to conditions in outer space. First of all, there are many formal and technical reasons and arguments why the Chicago system cannot be applied to outer space. In Article 1 of the Chicago Convention, we find the concept of the 'complete and exclusive sovereignty' of the State 'over the air space above its territory. 'Article 3 states that the Convention applies to civil aircraft and the definition of the term 'aircraft' is the same as that contained in Annex A of the Paris Convention of 1919; that is, 'all machines which can derive support in the atmosphere from reaction of the air.' Both the word aircraft and its definition are hardly applicable to conditions in space since in space there is no air or atmosphere. Apart from these purely formal arguments there are very important technical facts which prevent the application of the principle of State sovereignty to outer space. The sovereignty of the State has two main characteristics. One is the fact that sovereignty must be real in the sense that it can be defended by the State which claims it. The other characteristic is that, ff the claim is to be based on a fact, one must know exactly where this fact occurred. Neither of these characteristics can be found in outer space. First of all, in view of the present technological development, no State can defend its right of sovereignty at an altitude of 2,000 miles, for example. Furthermore, it is impossible to so locate an occurrence 2,000 miles in space that one could say that it took place in the sovereign regions of Belgium or of neighbouring Holland. The majority of theorists agree that the system of the Chicago Convention is not applicable to the conditions of outer space. Therefore, with flights in space being more and more common we are presented with the dangerous possibility that outer space is at present a legal vacuum. This fact became obvious when the satellites began their journies round the earth. Article 8 of the Chicago Convention was completely forgotten and no one protested against the flights of the satellites.
Author
Space Law; Airspace; Civil Aviation; Sovereignty

20050186983 New York Law School, New York, NY, USA
On the Threshold of Space: Toward a Cosmic Law. Problems of the Upward Extent of Sovereignty
Gorove, Stephen; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 69-76; In English; See also 20050186958; Copyright; Avail: Other Sources

For the second time in our generation we are witnessing the unfolding of a great scientific evolution which, in the scope of its boundless aspirations, infinite promises, and challenge-ridden perspectives, represents a panoramic phase with hardly a parallel in our history. The gigantic rockets that hirted the artlficial moons, the boldest creations oI human inventiveness, did much more than place instrument-bearing satellites in orbit around the earth. They lifted man's imagination out of his captive environment and gave a new impetus to, and a realistic expectation of, the fulfilment of his age-old dream: the conquest of space. This outstanding victory of science over the mighty forces of nature seems to have put mankind on the very threshold of space. Scientists tell us that space travel is no longer outside the realm of possibility. A lunar voyage is feasible by applying the basic scientific knowledge and technological know-how available to us today. While many technical problems remain to be solved, voyages to Mars and other planets seem sure to follow in the not too distant future. Such explorations are not only expected to shed light on many hitherto unexplained phenomena in space but will, no doubt, inaugurate new principles of communications and new dimensions of travel. Already from the studies of the current International Geophysical Year, solutions to many problems are foreshadowed, such as disposal of atomic wastes, long-range levels and productivity of the oceans, exploration and resources development in the Antarctica, distribution of oil and mineral deposits, prediction of earthquakes and volcanic eruptions. In addition, benefits are expected to irrigation and agriculture, weather forecasting, radar

and electronics, radio, telephone and television systems. The information obtained is likely to result in a better understanding of the atom, and may well revolutionize our concept of the universe.
Author
Volcanoes; Universe; Television Systems; Mineral Deposits; Agriculture; Sovereignty

85
TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety, 16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

20050192340 NASA Glenn Research Center, Cleveland, OH, USA
Atomic Oxygen Used to Restore Artworks
Banks, Bruce A.; Miller, Sharon K.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Techniques developed at the NASA Glenn Research Center to produce atomic oxygen in order to simulate the low-Earth-orbit environment for spacecraft materials testing can also be applied in the field of art restoration. Defaced or fire-damaged artwork can be treated with atomic oxygen to remove the damage and enable restoration that could not be accomplished with conventional methods. The process has been patented (U.S. Patents 5,560,781 and 5,693,241) and has been used to restore several works of art.
Author
Arts; Paints; Cleaning; Restoration; Oxygen Atoms; Aerospace Technology Transfer

88
SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

20050186950 International Astronautical Federation, Unknown
Space Exploration: The Problems of Today, Tomorrow and in the Future
Haley, Andrew G.; Proceedings of the Second Colloquium on the Law of Outer Space; [1960], pp. 44-58; In English; See also 20050186936; Copyright; Avail: Other Sources

Effective exploration of outer space by human beings must await the development of propulsion systems generating millions of pounds of thrust, with exhaust velocities in the order of one-third to one-half the speed of light. For cruising capacities and speeds such power plants appear, in nature, to be quite feasible and probably will be developed. The limiting factors are entirely human, or, more appropriately stated, are entirely anthropocentric. This is because the limiting factors center around the ability of the human being to withstand physically the stress of acceleration and deceleration to and from the luminar cruising speed. As a long-range problem for solution mankind has every reason to believe that the problem of physical stress will be conquered. But what of the immediate problems of the conquest of outer space ? Is outer space still closed to man and his artifacts, and therefore is it almost absurd to spend time in pondering upon sovereignty and jurisdiction and evolving special principles of jurisprudence ? Are we still at the outer space stage comparable to the period when man had not invented the wheel or had as yet failed to domesticate beasts of burden or carrier animals ? What about man's scientific carrier pigeons the essential developments of means of communications ._Many radio frequencies are needed for communication between earth and vehicles in space, and between vehicles in space and earth; between earth and positions in space; and positions in space and earth; between two or more positions in space; between two or more space vehicles. Radio frequencies are essential, not only for all such forms of communication but also for numerous other purposes such as telemetering, tracking, guidance, radiopositioning (radar), and so on. Some few of the answers have already been fairly well ascertained. The students of the natural and social sciences are well aware of the achievements and implications of the Sputniks, Mechtas, Vanguards, Pioneers, Discoverers and Explorers, and of many other breeds of earth-orbiting, and lunar, venusian, martian, and solar probes and planets. Despite a certain amount of understandable security secrecy, there is also a great deal known about the scores of space-penetrating missiles developed and tested by many nations of the world, including France, Great Britain, U.S.S.R., and the USA. During the recent International Geophysical Year, 66 nations cooperated in probing the regions of outer space and in obtaining environmental data of value as far distant as the cislunar area. In retrospect

we find that 1 President, International Astronautical Federation; General Counsel, American Rocket Society; Haley, Wollenberg & Kenehan, 1735 DeSales Street, N.W., Washington 6, D.C., U.S.A.
Author
Space Exploration; Pioneer Space Probes; Propulsion System Configurations; Propulsion System Performance; Security; Tracking Radar

20050186965 USA House of Representatives, Washington, DC, USA
A Code for a New Frontier
Yeager, Philip B.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 116-121; In English; See also 20050186958; Copyright; Avail: Other Sources

Principles, like comets, have a way of reappearing throughout the ages. The obligation which faces men today, as they prepare to cast loose from their planet, is not a new one. That duty is to make sure the civilization of Earth reaches its ultimate destiny, to make sure that it is neither stunted nor destroyed enroute. It is a duty which has faced the men and women of the world from the beginnings of human evolution. Today it stands before us newly packaged, newly labelled in relation to the tremendous social problems inherent in Space exploration--but it is the same old Basic Obligation of Mankind. What it boils down to is this: man must use self-control and effectively adjust his differences ff his world is not to revert to the world of the jungle. And most people, I think, will agree that the jungle of today does not differ greatly from the jungle of 100,000 years ago. In other words, progress implies that we must continually develop new rules of behavior to fit new situations.
Author
Biological Evolution; Space Exploration; Comets; Tropical Regions

20050186970 Herr (Donald L.), Santa Monica, CA, USA
Technical Proposals
Herr, Donald L.; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 77-78; In English; See also 20050186958; Copyright; Avail: Other Sources

both the privilege and the honor to responsibly address to you my few remarks today, not as a lawyer but as a technologist, in the spirit of assistance and cooperation. For this privileged responsibility, I address my thanks to the Chair and Firstly, on the matter of nomenclature, I am not at all impressed by the many times suggested use of mere altitude, in miles off Earth's surface--and the use of the various air-age names for the different altitude bands or regions. Rather, I should like to recommend for serious consideration and, I hope, ultimate acceptance--in the interests of flexibility, unrestricted adequacy and unbounded extension throughout Space--a nomenclature in which regions of space carry (1) the name of the closest determining mass, (2) the name of the primary (or primary and secondary) physical phenomenon characteristically representing and defining the space-region, (3) the use of successive Roman numerals for recurrence of that type of characteristic space-region. Thus, Earth-Proton-II would define a second volume of space near Earth characterized as a proton belt or band. It is believed that these means provide--at least for a few human generations- an unbounded, meaningful, named mapping, using a finite number of definitive words, of the overlapping volumes of Space as they are discovered, explored and understood. Secondly, I should like to suggest most respectfully to the international jurists of this Space-Law Colloquium and to its continuations that great care and reasonable caution be exercised in order to avoid injection into the fundamental body of Space-Law hidden, unexpected and unnecessary legal 'booby-traps' (based upon fundamentally erroneous interpretation or extrapolation of scientific fact and technological feasibility). We still find and pay either penalties for or homage to such legal booby-traps in both the International Rules of the Road at sea and in the corresponding International Rules for air transport and navigation. Close, amiable collaboration--as staff assistants to you lawyers--of fundamentalist scientists and engineers seems vital.
Author
Alphanumeric Characters; Space Law; Scientists; Nomenclatures; Navigation; Air Transportation; Engineers

20050186973 Naval Research Lab., Washington, DC, USA
Definition of Air Space
Jastrow, Robert; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 82; In English; See also 20050186958; Copyright; Avail: Other Sources

The definition of air space is a matter of fundamental interest in jurisprudence, but it also poses an interesting physical problem. The boundary to the air space of a nation may be defined with respect to possible regimes of flight, as suggested by Professor vo_ K_RM$,N. However, I believe that outer space must be defined as the region traversed by vehicles which have been placed in orbit around the earth, or which have escaped from the gravitational attraction o/ the earth. The reference to

orbiting vehicles, or satellites, immediately introduces the possibility of a physically sound definition for the limits of air space. I have in mind the fact that at low altitudes a satellite is quickly destroyed by atmospheric friction. In order to be considered an orbiting satellite, the vehicle must last for at least one circuit of the earth before destruction by friction. Therefore, I suggest that the boundary to the air space of a nation should be defined as the altitude at which the density of the atmosphere is sufficiently low to permit the completion of one circuit by an orbiting vehicle, without destruction by atmospheric friction. Our calculations of satellite lifetimes indicate that this critical altitude is 100 miles for a satellite of a typical weight and dimensions, i. e., a weight of one ton and a cross sectional area of 30 square feet. The critical altitude of 100 miles will vary by approximately 5 miles when allowance is made for the uncertainty of the density of the atmosphere at that altitude, and also for reasonable variations in satellite mass and cross sectional area, or more properly, the ratio of these last two quantities. This figure of 5 miles represents the degree of arbitrariness in the proposed definition.
Author
Airspace; Artificial Satellites; Boundaries; Friction

20050186982 Air Univ., Randolph, AFB, TX, USA
Definitions and Subdivisions of Space. Bioastronautical Aspect
Strughold, Hubertus; Proceedings of the First Colloquium on the Law of Outer Space; [1959], pp. 110-113; In English; See also 20050186958; Copyright; Avail: Other Sources

Whenever matters of astronautics are discussed, the word space is used in a great variety of ways, such as outer space, deep space, free space, interplanetary space, cosmic space, and so on. But space is an immensely vast area even within our solar system and its environmental conditions are by no means uniform. We need an exact definition of what is meant by these terms, where above the earth's surface space begins, and what subdivisions of space may be conceivable and practical. In brief, we now need a kind of 'geography of space,'--what we might call spatiography. This field refers, of course, only to the empty space itself. The description of the environmental conditions on the celestial bodies is called planetography, of which geography (Earth), areography (Mars), and selenography (Moon) are special cases. Both spatiography and planetography are subdivisions of an all embracing cosmography. In the following we shall confine our discussion to the space of the solar system based essentially on space medical considerations or on bioastronautics. A spatiography of this kind may also be useful for other aspects of astronautics such as space technology and space law. The first and perhaps the most important question that interests us is : Where above the earth's surface does space begin ? According to theories in astrophysics, the atmosphere as a material continuum extends to about 1000 kilometers, or 600 miles. In this region collisions between air molecules or atoms become very rare and the atmosphere thins out in the form of a spray zone (exosphere) into the nearly perfect vacuum of space. But this astrophysical aspect is not relevant to astronautics and especially not to manned space flight. In this respect the cessation of the atmospheric functions and effects determine the border between atmosphere and space. Without going into details-- As low as 15 km (about 10 mi.) and 20 km (12 mi.), the atmospheric pressure functions to provide the lungs with oxygen and to keep the body fluids in the liquid state are no longer effective. At about 25 km (16 mi.) the air, due to its low density, can no longer be utilized for cabin pressurization; instead we need a sealed cabin the same type as is required in space. At 40 km (24 mi.) we are beyond the region of absorption for cosmic rays. The same is true at 45 km (28 mi.) concerning ultraviolet of solar radiation. The 50 km (30 mi.) level is about the limit for aerodynamic lift and navigation even for the fastest winged craft.
Author
Aerospace Engineering; Atmospheric Effects; Bioastronautics; Manned Space Flight; Interplanetary Space; Interstellar Space; Exosphere; Space Law

20050192154 NASA Glenn Research Center, Cleveland, OH, USA
NASA Ground-Truthing Capabilities Demonstrated
Lopez, Isaac; Seibert, Marc A.; Research and Technology 2003; May 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA Research and Education Network (NREN) ground truthing is a method of verifying the scientific validity of satellite images and clarifying irregularities in the imagery. Ground-truthed imagery can be used to locate geological compositions of interest for a given area. On Mars, astronaut scientists could ground truth satellite imagery from the planet surface and then pinpoint optimum areas to explore. These astronauts would be able to ground truth imagery, get results back, and use the results during extravehicular activity without returning to Earth to process the data from the mission. NASA's first ground-truthing experiment, performed on June 25 in the Utah desert, demonstrated the ability to extend powerful computing resources to remote locations. Designed by Dr. Richard Beck of the Department of Geography at the University of Cincinnati, who is serving as the lead field scientist, and assisted by Dr. Robert Vincent of Bowling Green State University, the

demonstration also involved researchers from the NASA Glenn Research Center and the NASA Ames Research Center, who worked with the university field scientists to design, perform, and analyze results of the experiment. As shown real-time Hyperion satellite imagery (data) is sent to a mass storage facility, while scientists at a remote (Utah) site upload ground spectra (data) to a second mass storage facility. The grid pulls data from both mass storage facilities and performs up to 64 simultaneous band ratio conversions on the data. Moments later, the results from the grid are accessed by local scientists and sent directly to the remote science team. The results are used by the remote science team to locate and explore new critical compositions of interest. The process can be repeated as required to continue to validate the data set or to converge on alternate geophysical areas of interest.
Derived from text
Ground Truth; NASA Space Programs; Satellite Imagery

20050192346 NASA Glenn Research Center, Cleveland, OH, USA
Contaminated Solar Array Handrail Samples Retrieved From Mir Analyzed
deGroh, Kim K.; McCue, Terry R.; Research and Technology 1999; March 2000; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In January 1998 during the shuttle STS 89 mission, an eight-section Russian solar array panel was retrieved after more than 10 years of exposure to the orbital space environment on Mir. The array was deployed June 16, 1987, and removed on November 3, 1997. It had been actively used as a source of electrical power for 8 years. This operational array had been located on the Mir core module, located directly above the Kvant-2 module. Its retrieval provided a unique opportunity to study the effects of the low-Earth-orbit environment on a functional solar array. The intact solar array underwent scientific inspections and preliminary tests by a joint team of U.S. and Russian investigators to evaluate the effects of long-term space exposure. Upon initial examination, significant contamination was observed over most components of the array. One panel, panel 8, was provided to the U.S. scientists for further evaluation. As part of the U.S. investigations, two solar array handrail samples from panel 8 were evaluated for contamination at the NASA Glenn Research Center at Lewis Field. One is a section of a rigid handrail, and the other is a section of woven fabric tape that was overwrapped around a flexible handhold. Both the flexible handhold woven fabric and the rigid handrail were significantly darkened after 10 years of space exposure. They were evaluated with optical microscopy, field emission scanning electron microscopy (FESEM), and energy-dispersive spectroscopy. Solar absorptance and room-temperature emittance values also were obtained. The returned contaminated solar array segment is very similar in design to the solar arrays being supplied by the Russians for the International Space Station. Therefore, it was desirable to determine what the contaminants on various surfaces are and what the sources of the contamination were.
Author
Space Shuttle Missions; Solar Arrays; Aerospace Environments; Contaminants; Kvant Modules

20050192464 NASA Johnson Space Center, Houston, TX, USA
Fluctuations in Conjunction Miss Distance Projections as Time Approaches Time of Closest Approach
Christian, John A., III; July 2005; 36 pp.; In English
Report No.(s): NASA/TP-2005-213159; S-953; No Copyright; Avail: CASI; A03, Hardcopy

A responsibility of the Trajectory Operations Officer is to ensure that the International Space Station (ISS) avoids colliding with debris. USA Space Command (USSPACECOM) tracks and catalogs a portion of the debris in Earth orbit, but only objects with a perigee less than 600 km and a radar cross section (RCS) greater than 10 cm-objects that, in fact, represent only a small fraction of the objects in Earth orbit. To accommodate for this, the ISS uses shielding to protect against collisions with smaller objects. This study provides a better understanding of how quickly, and to what degree, USSPACECOM projections tend to converge to the final, true miss distance. The information included is formulated to better predict the behavior of miss distance data during real-time operations. It was determined that the driving components, in order of impact on miss distance fluctuations, are energy dissipation rate (EDR), RCS, and inclination. Data used in this analysis, calculations made, and conclusions drawn are stored in Microsoft Excel log sheets. A separate log sheet, created for each conjunction, contains information such as predicted miss distances, apogee and perigee of debris orbit, EDR, RCS, inclination, tracks and observations, statistical data, and other evaluation/orbital parameters.
Author
Debris; International Space Station; Miss Distance; Trajectories; Radar Cross Sections; Real Time Operation

89
ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20050188503 NASA Lewis Research Center, Cleveland, OH, USA

Cassini Radio Science Experiments on Saturn and Titan Preserved Because of Lewis Analysis

Wilson, Jeffrey D.; Research and Technology 1998; April 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Cassini mission to Saturn is an international venture with participation from NASA, the European Space Agency, and the Italian Space Agency. The Cassini spacecraft was launched from Cape Canaveral in October 1997 and is scheduled to arrive at Saturn in July 2004. After arrival, the spacecraft will orbit Saturn about 60 times over a period of 4 years. During this time, the Cassini Radio Science Subsystem will be used to investigate the atmosphere and rings of Saturn and the atmosphere of its largest moon, Titan--which is larger than Mercury and is the only moon in our solar system with a dense atmosphere. A critical component in Cassini s Radio Science Subsystem is a traveling-wave tube (TWT) that was designed at the NASA Lewis Research Center and built by Hughes Electronic Dynamics Division (ref. 1). This TWT will amplify downlink microwave signals at a frequency of 32 GHz for the Deep Space Network and will be involved in a number of experiments. These include occultation experiments in which the microwave signal will be beamed through rings and atmospheres toward Earth. Researchers will analyze the received signals to determine the sizes and distributions of the particles in the rings and the structure and composition of the atmospheres. The Radio Science Subsystem also will also be used to more accurately determine the mass and size of Saturn and its moons, to investigate the solar corona, and to search for gravity waves from outside the solar system.

Derived from text

Cassini Mission; Deep Space Network; Saturn Atmosphere; Titan; Radio Astronomy

20050189181 Naval Observatory, Washington, DC USA

Celestial Pole Offsets: Conversion From (dX, dY) to (d(psi), d(epsilon). Version 3

Kaplan, George H.; May 2005; 5 pp.; In English

Report No.(s): AD-A434208; No Copyright; Avail: CASI; A01, Hardcopy

Resolutions B1.6-B1.8 of the 2000 IAU General Assembly established the IAU 2000A precession-nutation model; defined more precisely what is meant by the celestial pole; and provided a new definition of UT1 in terms of an angle that directly measures the rotation of Earth in the celestial reference system. These resolutions represent major changes in the way in which the instantaneous orientation of the Earth is to be computed. In particular, the equinox is no longer a fundamental reference point and sidereal time is no longer needed for this computation. However, Resolution B1.8 contains the following provision: '.. .the IERS will continue to provide users with data and algorithms for the conventional transformations.' Thus, the IERS (International Earth Rotation and Reference Systems Service) has published a new expression for sidereal time consistent with the new definition of UT1....Thus, in the long term, only dX and dY will be available from the IERS.

DTIC

Celestial Navigation; Earth Rotation; Solar Orbits

20050189182 Naval Observatory, Washington, DC USA

The Motion of Mars' Pole II. The Effect of an Elastic Mantle and a Liquid Core

Hilton, James L.; Oct. 1991; 20 pp.; In English

Report No.(s): AD-A434206; No Copyright; Avail: CASI; A03, Hardcopy

A first-order approximation of the effects of an elastic mantle and liquid core on the motion of Mars' pole are explored. The effect on Mars' Chandler wobble (Eulerian free nutation) is much less dependent on Mars' structure than the Earth's Chandler wobble depends on the Earth's structure. The period of the liquid core free-core nutation (FCN), however, is found to be very sensitive to the mean core radius; if the FCN period is known with an uncertainty of 2 days, then the mean core radius can be inferred with an uncertainty of only 6 km. The amplitude of the forced nutation in the liquid core models is also sensitive to the mean core radius. The sensitivity is high enough that measuring of the amplitudes of the three largest nutation components with an accuracy of a milliarcsecond will produce measures of the mean core radius with uncertainties of 32, 38, and 67 km, respectively. Elastic mantle, solid core models, however, are found to produce no significant difference in the motion of the pole compared to the rigid solid core model. Evidence for some sort of nonrigid polar motion is shown to exist from the Viking lander radar ranges of Mars. methods of obtaining higher quality observations of Mars' orientation in space,

and the applicability of the methods derived for Mars to other planets in the solar system are discussed.
DTIC
Mars (Planet); Planetary Cores; Planetary Mantles

20050192398 NASA Glenn Research Center, Cleveland, OH, USA
Prototype Motor Controllers Demonstrated for the James Webb Space Telescope Cryogenic Environment
Patterson, Richard L.; Hammond, Ahmad; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

NASA is in the process of designing the James Webb Space Telescope. This telescope will investigate images of objects in deep space (stars, galaxies, etc.) by using light in the infrared region of the light spectrum. To make such observations, the telescope must have light sensors that operate at very cold temperatures, near absolute zero. To achieve this low-temperature tolerance, designers must place the light sensors behind a Sun shield that will prevent sunlight, and its heat, from reaching the sensors. In this cold region inside the telescope, electric motors and some motor controls must operate at temperatures near 40 K (40 degrees above absolute zero). These motors will be used to position light filters needed by the telescope. There are motors that operate at the low temperatures, but there is little technology for low-temperature motor-control electronics. The drawing shows how the motors and their controls are positioned behind the Sun shield. Simplified version of the layout of the motor and control electronics that are located, as dictated by mission requirements, in the cold zone of the James Webb Space Telescope. A Sun shield provides protection and isolation of these electronics from the heat of the rays of the sun. Room temperature compoenets (control computer, motor select command, motor phase drive, power supply, parallel to serial, and sun shield) as well as 40-kelvin components (motor select, serial to parallel, and motors) are shown. The Low Temperature Electronics Group at the NASA Glenn Research Center has been working to develop motor control electronics that will operate at a temperature of 40 K. The group conducted tests to determine which electronic components will operate at such very low temperatures. Then, components that were determined to operate successfully at the low temperatures were used to design low-temperature motor-controller circuits. A prototype motor controller circuit was built, evaluated, and demonstrated to operate at 70 K. Next, Glenn researchers plan to determine circuit performance at much colder temperatures--down to 40 K. This low-temperature program was supported by the James Webb Space Telescope Electrical Systems Design Group at the NASA Goddard Space Flight Center and by the NASA Electronic Parts and Packaging Program at NASA Headquarters and the Jet Propulsion Laboratory.
Author
Cryogenics; James Webb Space Telescope; Prototypes; Electric Motors

90
ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20050187103 Iowa State Univ. of Science and Technology, Ames, IA USA
VHE Gamma-ray Astronomy at Iowa State University, 1991-2000
Jan. 2001; 20 pp.; In English
Contract(s)/Grant(s): DOE/DE-FG02-91ER40634
Report No.(s): DE2005-809084; No Copyright; Avail: Department of Energy Information Bridge

A brief summary of the important results and listing of publications which have resulted from the Iowa State University Very High Energy Gamma-ray Astrophysics Program for the decade 1991-2000 are given.
NTIS
Astrophysics; Gamma Ray Astronomy

20050189206 Lawrence Livermore National Lab., Livermore, CA USA
New Detailed Term Accounting Opacity Code: TOPAZ
Iglesias, C. A.; Chen, M. H.; Isaacs, W.; Sonnad, V.; Wilson, B. G.; May 04, 2004; 14 pp.; In English
Report No.(s): DE2005-15014226; UCRL-PROC-203973; No Copyright; Avail: Department of Energy Information Bridge

A new opacity code, TOPAZ, which explicitly includes configuration term structure in the bound-bound transitions is being developed. The goal is to extend the current capabilities of detailed term accounting opacity codes such as OPAL that are limited to lighter elements of astrophysical interest. At present, opacity calculations of heavier elements use statistical methods that rely on the presence of myriad spectral lines for accuracy. However, statistical approaches have been shown to

be inadequate for astrophysical opacity calculations. An application of the TOPAZ code will be to study the limits of statistical methods. Comparisons of TOPAZ to other opacity codes as well as experiments are presented.
NTIS
Astrophysics; Opacity

20050189226 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA USA, Stanford Linear Accelerator Center, Stanford, CA, USA
Self-Dual Nonsupersymmetric Type II String Compactifications
Kachru, S.; Silverstein, E.; Aug. 1998; 14 pp.; In English
Report No.(s): DE2005-836359; LBNL-42139; SLAC-PUB-7907,UCB-PTH-98/40; No Copyright; Avail: Department of Energy Information Bridge

It has recently been proposed that certain nonsupersymmetric type II orbifolds have vanishing perturbative contributions to the cosmological constant. We show that techniques of Sen and Vafa allow one to construct dual type II descriptions of these models (some of which have no weakly coupled heterotic dual). The dual type II models are given by the same orbifolds with the string coupling S and a T2 volume T exchanged. This allows us to argue that in various strongly coupled limits of the original type II models, there are weakly coupled duals which exhibit the same perturbative cancellations as the original models.
NTIS
String Theory; Strings; Supersymmetry

20050192425 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Participation in the Analysis of the Far-Infrared/Submillimeter Interferometer
Lorenzini, Enrico C.; Bombardelli, Claudio; July 2005; 35 pp.; In English
Contract(s)/Grant(s): NNG04GQ21G; No Copyright; Avail: CASI; A03, Hardcopy

We have contributed to the development of the Submillimeter Probe of the Evolution of Cosmic Structure (SPECS) by analyzing various aspects related to the tethers that connect the spacecraft of this space interferometer. We have focused our analysis on key topics as follows: (a) helping in the configuration selection; (b) computing the system eigenfrequencies as a function of baseline length; (c) developing techniques and conceptual design of devices for damping the tether oscillations; (d) carrying out numerical simulations of tethered formation to assess the effects of environmental perturbations upon the baseline length variation; (e) devising control laws for fast retargeting of the interferometer at moderate baseline lengths; (f) estimating the survivability to micrometeoroid impacts of a tether at L2; and (g) developing a conceptual design of a high-strength and survivable tether.
Author
Submillimeter Waves; Far Infrared Radiation; Infrared Interferometers; Tetherlines; Perturbation

91
LUNAR AND PLANETARY SCIENCE AND EXPLORATION

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

20050192063 Boston Univ., Boston, MA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
Tomographic Reconstructions Using Map Algorithms-- Application to the SPIDR Mission
Roy, D. N.; Cook, T. A.; Chakrabarti, S.; Wilton, K.; January 2005; 26 pp.; In English
Report No.(s): DE2005-838183; No Copyright; Avail: Department of Energy Information Bridge

The spectral image of an astronomical scene is reconstructed from noisy tomographic projections using maximum a posteriori (MAP) and filtered backprojection (FBP) algorithms. Both maximum entropy (ME) and Gibbs prior are used in the MAP reconstructions. The scene, which is a uniform background with a localized emissive source superimposed on it, is reconstructed for a broad range of source counts. The algorithms are compared regarding their ability to detect the source in the background. Detectability is defined in terms of a contrast-to-noise ratio (CNR) which is a Monte Carlo ensemble average of spatially averaged CNRs for the individual reconstructions. Overall, MAP was found to yield improved CNR relative to

FBP. Moreover, as a function of the total source counts, the CNR varies distinctly different for source and background regions. This may be important in separating a weak source from the background.
NTIS
Algorithms; Tomography; Space Missions

20050192264 NASA Glenn Research Center, Cleveland, OH, USA
Solar Airplane Concept Developed for Venus Exploration
Landis, Geoffrey A.; Research and Technology 2003; May 2004; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

An airplane is the ideal vehicle for gathering atmospheric data over a wide range of locations and altitudes, while having the freedom to maneuver to regions of scientific interest. Solar energy is available in abundance on Venus. Venus has an exoatmospheric solar flux of 2600 W/m2, compared with Earth's 1370 W/m2. The solar intensity is 20 to 50 percent of the exoatmospheric intensity at the bottom of the cloud layer, and it increases to nearly 95 percent of the exoatmospheric intensity at 65 km. At these altitudes, the temperature of the atmosphere is moderate, in the range of 0 to 100 degrees Celsius, depending on the altitude. A Venus exploration aircraft, sized to fit in a small aeroshell for a 'Discovery' class scientific mission, has been designed and analyzed at the NASA Glenn Research Center. For an exploratory aircraft to remain continually illuminated by sunlight, it would have to be capable of sustained flight at or above the wind speed, about 95 m/sec at the cloud-top level. The analysis concluded that, at typical flight altitudes above the cloud layer (65 to 75 km above the surface), a small aircraft powered by solar energy could fly continuously in the atmosphere of Venus. At this altitude, the atmospheric pressure is similar to pressure at terrestrial flight altitudes.
Derived from text
Space Exploration; Venus Surface

20050192432 NASA Glenn Research Center, Cleveland, OH, USA
Power-Conversion Concept Designed for the Jupiter Icy Moons Orbiter
Mason, Lee S.; Research and Technology 2003; May 2004; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Jupiter Icy Moons Orbiter (JIMO) is a bold new mission being developed by NASA's Office of Space Science under Project Prometheus. JIMO is examining the potential of nuclear electric propulsion (NEP) technology to efficiently deliver scientific payloads to three of Jupiter's moons: Callisto, Ganymede, and Europa. A critical element of the NEP spacecraft is the space reactor power system (SRPS), consisting of the nuclear reactor, power conversion, heat rejection, and power management and distribution (PMAD).
Derived from text
Ganymede; Ice; Jupiter (Planet); Solar Cells; Solar Generators; Spacecraft Power Supplies

92
SOLAR PHYSICS

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

20050186910 Washington Univ., Saint Louis, MO, USA
The History of Presolar Grains
Bernatowicz, Thomas J.; [2004]; 6 pp.; In English
Contract(s)/Grant(s): NAG5-10426; No Copyright; Avail: CASI; A02, Hardcopy

Below we summarize the results of our investigations into the history of presolar grains that were conducted in the last year. During this time we have expended much of our effort in the development of experimental techniques and sample preparation methods that are needed to laboratory in December, 2000. Specific information on this instrument is contained in the Full Proposal of PI Ernst Zinner and will not be repeated here. Our general strategy in the past year has been in large measure to explore novel sample handling methods for the very small (sub-micron), but more representative, presolar grains that can now be characterized isotopically in the NanoSIMS. We have developed experimental techniques that will permit NanoSIMS analyses of the very same ultramicrotome sections studied in the TEM, and we have developed grain dispersion, handling and mounting techniques that permit NanoSIMS isotopic analysis as well as field emission SEM, high energy TEM, and atomic force microscopy of pristine presolar grains. Although much of this has been slow and very difficult work that has no immediate payoff in terms of publishable results, we considered it absolutely necessary groundwork for future discoveries, especially in the realm of individual presolar grains that have been inaccessible to past studies due to size constraints. As

discussed below, we have been largely successful in these endeavors, and expect to reap the benefits of this work in the next year. We also report on our continued morphologic studies of pristine presolar grains, on our investigations of presolar graphite grains from supernovae as well as on rarer types of presotar SIC, on the search for presolar silicates, and on our efforts to obtain direct size-distribution information on presolar SiC through X-ray mapping techniques.
Derived from text
Isotopes; Atomic Force Microscopy; Size Distribution; Graphite

20050187008 NASA Lewis Research Center, Cleveland, OH, USA
Solar Array Verification Analysis Tool (SAVANT) Developed
Bailey, Sheila G.; Long, KIenwyn J.; Curtis, Henry B.; Gardner, Barbara; Davis, Victoria; Messenger, Scott; Walters, Robert; Research and Technology 1998; August 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Modeling solar cell performance for a specific radiation environment to obtain the end-of-life photovoltaic array performance has become both increasingly important and, with the rapid advent of new types of cell technology, more difficult. For large constellations of satellites, a few percent difference in the lifetime prediction can have an enormous economic impact. The tool described here automates the assessment of solar array on-orbit end-of-life performance and assists in the development and design of ground test protocols for different solar cell designs. Once established, these protocols can be used to calculate on-orbit end-of-life performance from ground test results. The Solar Array Verification Analysis Tool (SAVANT) utilizes the radiation environment from the Environment Work Bench (EWB) model developed by the NASA Lewis Research Center s Photovoltaic and Space Environmental Effects Branch in conjunction with Maxwell Technologies. It then modifies and combines this information with the displacement damage model proposed by Summers et al. (ref. 1) of the Naval Research Laboratory to determine solar cell performance during the course of a given mission. The resulting predictions can then be compared with flight data. The Environment WorkBench (ref. 2) uses the NASA AE8 (electron) and AP8 (proton) models of the radiation belts to calculate the trapped radiation flux. These fluxes are integrated over the defined spacecraft orbit for the duration of the mission to obtain the total omnidirectional fluence spectra. Components such as the solar cell coverglass, adhesive, and antireflective coatings can slow and attenuate the particle fluence reaching the solar cell. In SAVANT, a continuous slowing down approximation is used to model this effect.
Author
Solar Arrays; Proving; Radiation Belts; Aerospace Environments; Environment Effects; Performance Tests; Performance Prediction

20050187010 NASA Lewis Research Center, Cleveland, OH, USA
Space Plasma Shown to Make Satellite Solar Arrays Fail
Ferguson, Dale C.; Research and Technology 1998; August 1999; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In 1997, scientists and engineers of the Photovoltaic and Space Environments Branch of the NASA Lewis Research Center, Maxwell Technologies, and Space Systems/Loral discovered a new failure mechanism for solar arrays on communications satellites in orbit. Sustained electrical arcs, initiated by the space plasma and powered by the solar arrays themselves, were found to have destroyed solar array substrates on some Space Systems/Loral satellites, leading to array failure. The mechanism was tested at Lewis, and mitigation strategies were developed to prevent such disastrous occurrences on-orbit in the future. Deep Space 1 is a solar-electric-powered space mission to a comet, launched on October 24, 1998. Early in 1998, scientists at Lewis and Ballistic Missile Defense Organization (BMDO) realized that some aspects of the Deep Space 1 solar arrays were nearly identical to those that had led to the failure of solar arrays on Space Systems/Loral satellites. They decided to modify the Deep Space 1 arrays to prevent catastrophic failure in space. The arrays were suitably modified and are now performing optimally in outer space. Finally, the Earth Observing System (EOS) AM1, scheduled for launch in mid-1999, is a NASA mission managed by the Goddard Space Flight Center. Realizing the importance of Lewis testing on the Loral arrays, EOS-AM1 management asked Lewis scientists to test their solar arrays to show that they would not fail in the same way. The first phase of plasma testing showed that sustained arcing would occur on the unmodified EOS-AM1 arrays, so the arrays were removed from the spacecraft and fixed. Now, Lewis scientists have finished plasma testing of the modified array configuration to ensure that EOS-AM1 will have no sustained arcing problems on-orbit.
Author
Space Plasmas; Solar Arrays; Communication Satellites; Aerospace Systems; Aerospace Environments

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SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

20050188449 NASA Lewis Research Center, Cleveland, OH, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA

Synchrotron Vacuum Ultraviolet Light and Soft X-Ray Radiation Effects on Aluminized Teflon FEP Investigated

Dever, Joyce A.; Townsend, Jacqueline A.; Gaier, James R.; Jalics, Alice I.; Research and Technology 1998; April 1999; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Since the Hubble Space Telescope (HST) was deployed in low Earth orbit in April 1990, two servicing missions have been conducted to upgrade its scientific capabilities. Minor cracking of second-surface metalized Teflon FEP (DuPont; fluorinated ethylene propylene) surfaces from multilayer insulation (MLI) was first observed upon close examination of samples with high solar exposure retrieved during the first servicing mission, which was conducted 3.6 years after deployment. During the second HST servicing mission, 6.8 years after deployment, astronaut observations and photographic documentation revealed significant cracks in the Teflon FEP layer of the MLI on both the solar- and anti-solar-facing surfaces of the telescope. NASA Goddard Space Flight Center directed the efforts of the Hubble Space Telescope MLI Failure Review Board, whose goals included identifying the low-Earth-orbit environmental constituent(s) responsible for the cracking and embrittling of Teflon FEP which was observed during the second servicing mission. The NASA Lewis Research Center provided significant support to this effort. Because soft x-ray radiation from solar flares had been considered as a possible cause for the degradation of the mechanical properties of Teflon FEP (ref. 1), the effects of soft xray radiation and vacuum ultraviolet light on Teflon FEP were investigated. In this Lewisled effort, samples of Teflon FEP with a 100-nm layer of vapor-deposited aluminum (VDA) on the backside were exposed to synchrotron radiation of various vacuum ultraviolet and soft x-ray wavelengths between 18 nm (69 eV) and 0.65 nm (1900 eV). Synchrotron radiation exposures were conducted using the National Synchrotron Light Source at Brookhaven National Laboratory. Samples of FEP/VDA were exposed with the FEP surface facing the synchrotron beam. Doses and fluences were compared with those estimated for the 20-yr Hubble Space Telescope mission.

Derived from text

Hubble Space Telescope; Multilayer Insulation; Radiation Effects; Synchrotron Radiation; Teflon (Trademark); Ultraviolet Radiation

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GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20050192419 NASA Langley Research Center, Hampton, VA, USA

2004 ODU-HU NASA Faculty Fellowship Program

Tiwari, Surendra, Compiler; DePriest, Douglas, Compiler; Murray, Deborah B., Compiler; July 2005; 85 pp.; In English

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2004 NASA Faculty Fellowship Program final report on research and activities.

Author

NASA Programs; Education; Engineering

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