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Langley Research Center

**Scientific and Technical
Information Program Office**

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Introduction

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

- NASA, NASA contractor, and NASA grantee reports;
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- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses.

Also included are two indexes, Subject Term and Personal Author. The Subject Term Index is generated from the *NASA Thesaurus* terms associated and listed with each document.

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

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

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G. Mathematical and Computer Sciences
H. Physics
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J. Space Sciences
K. General

Indexes

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

Subject Term Index

Personal Author Index

Document Availability

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Subject Categories of the Division A. Aeronautics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

01 Aeronautics (General) 1

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*.

02 Aerodynamics 2

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 Heat Transfer.*

03 Air Transportation and Safety 13

Includes passenger and cargo air transport operations; aircraft 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*.

04 Aircraft Communications and Navigation 14

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *06 Avionics and Aircraft Instrumentation*; *17 Space Communications; Spacecraft Communications, Command and Tracking*, and *32 Communications and Radar.*

05 Aircraft Design, Testing and Performance 15

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*.

06 Avionics and Aircraft Instrumentation 16

Includes all avionics systems, cockpit and cabin display devices; and flight instruments intended for use in aircraft. For related information, see also *04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics;* and *35 Instrumentation and Photography.*

07 Aircraft Propulsion and Power 17

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

08 Aircraft Stability and Control N.A.

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*.

09 Research and Support Facilities (Air) 33

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).*

Subject Categories of the Division B. Astronautics

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12 Astronautics (General) 34

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*.

13 Astrodynamics N.A.

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

14 Ground Support Systems and Facilities (Space) 35

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

15 Launch Vehicles and Launch Operations 36

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.*

16 Space Transportation and Safety 36

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

17 Space Communications, Spacecraft Communications, Command and Tracking 41

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.*

18 Spacecraft Design, Testing and Performance 42

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.*

19 Spacecraft Instrumentation and Astrionics 44

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 Aircraft Instrumentation and Avionics;* For spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; For spaceborne telescopes and other astronomical instruments see *89 Astronomy, Instrumentation and Photography*; For spaceborne telescopes and other astronomical instruments see *89 Astronomy.*

20 Spacecraft Propulsion and Power 44

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*.

Subject Categories of the Division C. Chemistry and Materials

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

23 Chemistry and Materials (General) 48

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 24 through 29*. For astrochemistry see category *90 Astrophysics*.

24 Composite Materials 49

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

25 Inorganic, Organic, and Physical Chemistry 53

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

26 Metals and Metallic Materials 67

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

27 Nonmetallic Materials 69

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

28 Propellants and Fuels 74

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*.

29 Space Processing 77

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.*

Subject Categories of the Division D. Engineering

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

31 Engineering (General) 79

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

32 Communications and Radar 82

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.*

33 Electronics and Electrical Engineering 92

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.*

34 Fluid Mechanics and Thermodynamics 99

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.*

35 Instrumentation and Photography 103

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

36 Lasers and Masers 106

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*.

37 Mechanical Engineering 108

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*.

38 Quality Assurance and Reliability 114

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

39 Structural Mechanics 114

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

42 Geosciences (General) 118

Includes general research topics related to the Earth sciences, and the specific areas of petrology, minerology, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

43 Earth Resources and Remote Sensing 120

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see *35 Instrumentation and Photography.*

44 Energy Production and Conversion 120

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*.

45 Environment Pollution 123

Includes atmospheric, water, soil, noise, and thermal pollution.

46 Geophysics 130

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*.

47 Meteorology and Climatology 135

Includes weather observation forecasting and modification.

48 Oceanography 140

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*.

Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

51 Life Sciences (General) 141

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*.

52 Aerospace Medicine 160

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 Science*. For the effects of space on animals and plants see *51 Life Sciences*.

53 Behavioral Sciences 204

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

54 Man/System Technology and Life Support 211

Includes human factors engineering; bionics, man–machine, life support, space suits and protective clothing. For related information see also *16 Space Transportation* and *52 Aerospace Medicine*..

55 Exobiology N.A.

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 Science*.

Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

59 Mathematical and Computer Sciences (General) 218

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

60 Computer Operations and Hardware 219

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*.

61 Computer Programming and Software 220

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.

62 Computer Systems 224

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.

63 Cybernetics, Artificial Intelligence and Robotics 227

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

64 Numerical Analysis 228

Includes iteration, differential and difference equations, and numerical approximation.

65 Statistics and Probability 229

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

66 Systems Analysis and Operations Research 230

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

67 Theoretical Mathematics N.A.

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

70 Physics (General) 231

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*.

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Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.* For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion Propulsion and Power.*

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Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

73 Nuclear Physics 234

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*.

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77 Physics of Elementary Particles and Fields 239

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.*

Subject Categories of the Division I. Social and Information Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

80 Social Sciences (General) N.A.

Includes general research topics related to sociology; educational programs and curricula.

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Includes management planning and research.

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

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Includes cost effectiveness studies.

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88 Space Sciences (General) 247

Includes general research topics related to the natural space sciences. For specific topics in Space Sciences see *categories 89 through 93*.

89 Astronomy 247

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x–ray, ultraviolet, and infrared astronomy; and astrometry.

90 Astrophysics 249

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

91 Lunar and Planetary Science and Exploration 249

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*.

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

93 Space Radiation 253

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics.*

Subject Categories of the Division K. General

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

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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.

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Typical Report Citation and Abstract

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

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 38, MARCH10, 2000

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.

20000018018 NASA Glenn Research Center, Cleveland, OH USA
SBIR Success Stories at NASA Glenn Research Center
Kim, Walter S., NASA Glenn Research Center, USA; Bitler, Dean W., NASA Glenn Research Center, USA; Prok, George M., OMNI Corp., USA; Metzger, Marie E., OMNI Corp., USA; Dreibelbis, Cindy L., OMNI Corp., USA; Howe, Meghan R., OMNI Corp., USA; Novak, George D., OMNI Corp., USA; December 1999; 68p; In English
Contract(s)/Grant(s): RTOP 295-01-01
Report No.(s): NASA/TM-1999-209649; E-11997; NAS 1.15:209649; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This booklet of success stories summarizes the NASA Glenn Research Center's accomplishments and successes by the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. These success stories are the results of selecting projects that best support NASA missions and also have commercialization potential. Each success story describes the innovation accomplished, commercialization of the technology, and further applications and usages. The company name and the NASA contact person are identified to encourage further interest and communication to occur.
Author
NASA Programs; Technology Utilization; Government/Industry Relations

20000020785 Naval Postgraduate School, Monterey, CA USA
Safety Climate Assessment in Naval Reserve Aviation Maintenance Operations
Oneto, Todd J.; Sep. 1999; 104p; In English
Report No.(s): AD-A370934; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Naval Aviation's annual Class 'A' Flight Mishap rate is commonly used as a measure of safety effectiveness. Interventions implemented over the past four decades greatly reduced mishap occurence by focusing on aircrew and supervisory error. Less attention has been paid to the role maintenance plays in Naval Aviation mishaps, though it is consistently responsible for approximately 16 percent of all Class 'A' Flight Mishaps. In 1998, a Maintenance Climate Assessment Survey (MCAS) was developed to evaluate safety concerns from the perspective of an aircraft maintainer. This thesis utilized the revised MCAS to assess its validity and utility as a diagnostic tool to access several aircraft communities within the Naval Reserve. It proved useful in aiding Commanders and Aviation Safety Officers (ASOs) in evaluating their maintenance operation's safety posture. The results of this study produced a finalized MCAS for fleet wide distribution. The findings will serve to encourage proactiveness within aviation maintenance in the areas of safety awareness and risk management. This tool will also aid in the monitoring of ongoing safety programs or implementation of new ones.
DTIC
Navy; Aircraft Maintenance; Human Factors Engineering; Aircraft Safety; Military Aviation; Climate

20000020970 NASA Langley Research Center, Hampton,VA USA

Aeronautical Engineering: A Continuing Bibliography with Indexes

November 1999; 106p; In English

Report No.(s): NASA/SP-1999-7037/SUPPL409; NAS 1.21:7037/SUPPL409; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes-subject and author are included after the abstract section.

Author

Aeronautical Engineering; Bibliographies; Aerodynamics; Indexes (Documentation)

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 Heat Transfer.

20000014369 NASA Langley Research Center, Hampton, VA USA

1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, Volume 1, Configuration Aerodynamics

Hahne, David E., Editor, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; 876p; In English; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, 8-12 Feb. 1999, Anaheim, CA, USA; See also 20000014370 through 20000014384

Report No.(s): NASA/CP-1999-209704/VOL1/PT1; L-17911A; NAS 1.55:209704/VOL1/PT1; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

NASA's High-Speed Research Program sponsored the 1999 Aerodynamic Performance Technical Review on February 8-12, 1999 in Anaheim, California. The review was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in the areas of Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High Lift, and Flight Controls. The review objectives were to: (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientists and engineers working on HSCT aerodynamics. In particular, single and midpoint optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT simulation results were presented, along with executive summaries for all the Aerodynamic Performance technology areas. The HSR Aerodynamic Performance Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration. Thus, a fourth objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas of the HSR Program. This Volume 1/Part 1 publication covers configuration aerodynamics.

Author

Supersonic Transports; Aerodynamic Characteristics; Computational Fluid Dynamics; Aircraft Design; Body-Wing Configurations; Canard Configurations; Wing Nacelle Configurations; Engine Airframe Integration

20000014370 NASA Langley Research Center, Hampton, VA USA

Isolated Nozzle Analysis Using OVERFLOW

Wong, Tin-Chee, Analytical Services and Materials, Inc., USA; Deere, Karen A., NASA Langley Research Center, USA; Pao, S. Paul, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 1-20; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

LaRC conducted a code validation study for the OVERFLOW code to ascertain its accuracy for boattail drag prediction. The OVERFLOW results compared favorably with the LaRC 16-ft. Transonic Wind Tunnel (TWT) data, and prior CFD solutions from PAB3D and CFL3D. The ultimate goal is to investigate the installation drag of the nacelle boattails with powered nozzles at transonic mach numbers. The OVERFLOW solver was chosen because of its ability to accept volume overlapping structured grid for very complex airframe configurations. Structured grid components for representing the transonic nozzle boattail can be added to the BCAG grid for a TCA airframe with 2D bifurcated inlet and flow through nacelle without alteration. The focus of this research was to determine the suitability of the OVERFLOW solver for accomplishing this ultimate goal. This presentation will first introduce the transonic nozzle boattail wind-tunnel model geometry, followed by an examination of aerodynamic features based on the current OVERFLOW solutions and the solutions obtained previously using PAB3D, comparisons of Cp on the flap surface between the OVERFLOW solutions, wind tunnel data, and solutions from other CFD codes, an assessment of boattail drag count prediction, and a work plan for FY99.
Derived from text
Boattails; Nozzle Geometry; Transonic Nozzles; Pressure Distribution; Applications Programs (Computers); Inlet Flow; Aerodynamic Drag; Flow Distribution

20000014371 NASA Ames Research Center, Moffett Field, CA USA
PIE Nacelle Flow Analysis and TCA Inlet Flow Quality Assessment
Shieh, C. F., Boeing Co., USA; Arslan, Alan, Boeing Co., USA; Sundaran, P., Boeing Co., USA; Kim, Suk, Boeing Co., USA; Won, Mark J., NASA Ames Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 21-65; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This presentation includes three topics: (1) Analysis of isolated boattail drag; (2) Computation of Technology Concept Airplane (TCA)-installed nacelle effects on aerodynamic performance; and (3) Assessment of TCA inlet flow quality.
Derived from text
Nacelles; Inlet Flow; Computational Fluid Dynamics; Applications Programs (Computers); Transonic Nozzles; Supersonic Nozzles; Flow Distribution; Inlet Airframe Configurations; Supersonic Drag

20000014374 Boeing Commercial Airplane Co., Seattle, WA USA
Assessment of CFD Predictions of Flat Plate Skin Friction
Kulfan, Robert M., Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 253-300; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Recent CFD validation studies have shown significant variations in viscous drag predictions between the various methods used by the NASA and industry HSCT organizations. The methods include Navier Stokes CFD codes in which the viscous forces are part of the solutions, and predictions obtained from the different fully turbulent flow flat plate skin friction drag equations used by the various organizations. In this paper, the variation of these viscous drag predictions will be shown. The strategy developed to resolve these differences will be discussed. The first step in the resolution strategy was the development of a skin friction database for flat plate fully turbulent flow. This database will be briefly reviewed. The comparisons of CFD skin friction prediction by Boeing Phantom Works Long Beach, BPW-LB, by Boeing Commercial Aircraft aerodynamics, BCA, and by NASA Ames will be reviewed. The study conclusions will be summarized.
Derived from text
Computational Fluid Dynamics; Aerodynamic Characteristics; Viscous Drag; Skin Friction; Turbulent Flow; Applications Programs (Computers)

20000014375 Alpha Star Corp., Long Beach, CA USA
Progress Toward Viscous Drag Calculations, Part 2, Flow with Pressure Gradient over TCA Symmetric Wing/Body Configuration
Jafroudi, Hamid, Alpha Star Corp., USA; Mendoza, Raul, Boeing Co., USA; Hartwich, Peter, Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 365-400; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

In the second phase of viscous-drag prediction, the flow with pressure gradient was analyzed. For this study flow over TCA symmetric wing/body configuration was selected. The outline of my talk will be as followed: First, the objective and brief introduction will be given. The approach to this analysis will be described. The computational grid and grid topology will be

discussed. The turbulence models used for this study are described. The computational and empirical results will be presented. and finally, the summary of the analysis will be discussed.
Derived from text
Body-Wing Configurations; Drag Measurement; Pressure Gradients; Viscous Drag; Computational Fluid Dynamics; Navier-Stokes Equation

20000014376 Alpha Star Corp., Long Beach, CA USA
Progress Toward Viscous Drag Calculations, Part 1, Flow Over Flat Plate with No Pressure Gradient
Jafroudi, Hamid, Alpha Star Corp., USA; Mendoza, Raul, Boeing Co., USA; Hartwich, Peter, Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 301-364; In English; See also 20000014369; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

A systematic prediction capabilities of a state-of-the-art Navier-Stokes solver employed in HSR program for viscous drag for flow with and without pressure gradient was assumed and a computational database was built. The study of the viscous drag prediction capability of the CFL3D Navier-Stokes solver was conducted at Boeing Long Beach in two phases. In the first phase, Navier-Stokes solutions were correlated with experimental data for flows over a flat plate without pressure gradients. In the second phase, flows with pressure gradients were considered by examining the Technical Concept Airplane (TCA) symmetric wing/body configuration. The High Speed Research (HSR), Configuration Aerodynamics community has proposed a TCA symmetrical wing/body configuration in an effort to obtain a computational database for validation of viscous drag for wind-tunnel and flight Reynolds numbers. This model was also selected because wind-tunnel data become available for comparison in the near future. The study was performed for several turbulence models and the flow conditions (M(sub infinity) =0.31 to 2.40 at wind-tunnel and flight Reynolds numbers) were chosen such that they bracketed the transonic and supersonic cruise Mach numbers of an HSCT aircraft.
Author
Viscous Drag; Drag Measurement; Body-Wing Configurations; Navier-Stokes Equation; Applications Programs (Computers); Computational Fluid Dynamics; Turbulence Models

20000014377 NASA Ames Research Center, Moffett Field, CA USA
Overflow: Facts on Friction
Lawrence, Scott, NASA Ames Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 401-416; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents results of three minor studies into the behavior of the OVERFLOW with respect to the prediction of skin friction drag on wing bodies at cruise Mach number and wind tunnel Reynolds number. The studies include a preliminary assessment of the behavior of the two new 2-equation turbulence models introduced with the latest version of OVERFLOW (v. 1.8f), an investigation into potential improvements in the matrix dissipation scheme currently implemented in OVERFLOW, and an analysis of the observed sensitivity of the code's skin friction predictions to grid stretching at solid surface boundaries.
Author
Friction Drag; Skin Friction; Applications Programs (Computers); Turbulence Models; Computational Fluid Dynamics

20000014378 Boeing Co., Long Beach, CA USA
Canard Effectiveness Predictions
Wilson, Doug, Boeing Co., USA; Stanislaw, Greg, Boeing Co., USA; Flores, Servando, Boeing Co., USA; Kandula, Max, Dynacs Engineering, Inc., USA; Fargo, Gerald, Dynacs Engineering, Inc., USA; Saladino, Anthony, Dynacs Engineering, Inc., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 417-472; In English; See also 20000014369; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

This study grew from a fusion of related studies planned by the High-Speed Configuration Aerodynamics ITD Team (CA), and the Technology Integration (TI) team. The High Lift (HL) team also lent support as the study took place, to extend the study into the low-Mach regimes which actually establish the control surface sizes. In addition to providing data for a configuration decision on what planform to use for the canard, this study provided a test case for the application of current CFD tools to prediction of control effectiveness at high CL. As such, both the methodology and results are applicable to similar planforms used for vertical and horizontal tails. The results were intended to support various other analyses such as the canard position study being performed

at Boeing Phantom Works-Long Beach and the CFD validation studies planned to utilize the aft-body closure test data to be obtained in 1999.
Author
Canard Configurations; Computational Fluid Dynamics; Control Surfaces; Turbulence Models; Aerodynamic Drag

20000014379 Boeing Co., Long Beach, CA USA
Canard Integration Wind-Tunnel Tests and Computational Results
Magee, Todd E., Boeing Co., USA; Kubiatko, Paul, Boeing Co., USA; Kim, Suk C., Boeing Co., USA; Jafroudi, Hamid, Alpha Star Corp., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 473-620; In English; See also 20000014369; No Copyright; Avail: CASI; A07, Hardcopy; A10, Microfiche

This paper presents experimental and CFD investigations into the effect of canard integration on the TCA (Technology Concept Aircraft) aerodynamic performance and Stability & Control. Specifically, results from the Supersonic Canard Integration Wind Tunnel Test (Test 1705) at the NASA Langley UPWT (Unitary Plan Wind Tunnel) and the Transonic Canard Integration Wind Tunnel Test (Test 508) at the NASA Langley 16-foot Transonic Wind Tunnel are presented. Comparisons of this test data with extensive CFL3D computational fluid dynamic (CFD) solutions are shown, as well as the results of a CFL3D directional stability & control study for the full TCA configuration (wing/body/canard/empennage). CFL3D shows good correlation with the test data for all configurations tested, except the ACC (alternate controls concept) canard configuration at a canard incidence angle of 4 deg. Navier-Stokes results for both the Baldwin-Lomax and Menter's kappa-omega SST models are also shown. The CFL3D directional stability study indicates that the interaction of the PTC (Preliminary Technology Concept) canard tip vortices with the tail of the aircraft have a significant effect on directional stability. This tip vortex interaction is similar to low speed results which indicate a strong correlation between canard tip height and the angle-of-attack at which representative HSCT configurations become directionally unstable. Conditions for the studies presented in this paper range from M(sub infinity)= 0.6, 0.9, and 1.1 for the transonic studies to M(sub infinity)= 2.4 for the supersonic studies. Reynolds numbers for all studies were approximately 4 million/ft.
Author
Wind Tunnel Tests; Computational Fluid Dynamics; Canard Configurations; Applications Programs (Computers); Turbulence Models

20000014380 NASA Langley Research Center, Hampton, VA USA
Unstructed Navier-Stokes Analysis of Wind-Tunnel Aeroelastic Effects on TCA Model 2
Frink, Neal T., NASA Langley Research Center, USA; Allison, Dennis O., NASA Langley Research Center, USA; Parikh, Paresh C., Paragon Research Associates, Inc., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 621-640; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The aim of this work is to demonstrate a simple technique which accounts for aeroelastic deformations experienced by HSR wind-tunnel models within CFD computations. With improved correlations, CFD can become a more effective tool for augmenting the post-test understanding of experimental data. The present technique involves the loose coupling of a low-level structural representation within the ELAPS code, to an unstructured Navier-Stokes flow solver, USM3Dns. The ELAPS model is initially calibrated against bending characteristics of the wind-tunnel model. The strength of this method is that, with a single point calibration of a simple structural representation, the static aeroelastic effects can be accounted for in CFD calculations across a range of test conditions. No prior knowledge of the model deformation during the wind-on test is required. This approach has been successfully applied to the high aspect-ratio planforms of subsonic transports. The current challenge is to adapt the procedure to low aspect-ratio planforms typical of HSR configurations.
Derived from text
Computational Fluid Dynamics; Navier-Stokes Equation; Aeroelasticity; Applications Programs (Computers); Wind Tunnel Calibration

20000014381 Raytheon STX Corp., Moffett Field, CA USA
Automated Euler/Navier-Stokes Grid Generation/Grid Perturbation for Wing/Body Configuration
Saunders, David, Raytheon STX Corp., USA; Reuther, James, MCAT Inst., USA; Edwards, Stephen, California Univ., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 641-684; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This document describes the single-block wing/body grid generation package developed at NASA Ames Research Center during 1994-1998 as part of the design-by-optimization activities supporting the High Speed Research Program. Application of

the gridding to optimization requires complete automation for the initial full grid generated from scratch at the beginning of a design run, combined with an efficient means of perturbing that initial grid many times during the run. Use of a single-block flow solver by the design code has forced the use of a C-H topology. (The bulk of a C-O-type tip treatment has also been incorporated, but this option remains incomplete following experience with a preliminary implementation which traded other disadvantages for the better tip resolution.) It is well known that a C-H topology is adequate for plain wings, but less well-suited to wing/bodies. The present implementation has been refined enough that it probably represents the best that can be done for wing/bodies given the single-block restriction and the automation requirement. In combination with the single-block design code's pseudo-nacelle option for supersonic applications, this grid generator played a key role in the successful creation of the January 1997 Ames 01-03 refinement of the TCA-6 High Speed Civil Transport. Nearly two years later, initial efforts to optimize the full Ames 01-03 wing/body/nacelle/diverter configuration with the SYN107-MB multiblock design code suggest that the great bulk of the possible improvement over the baseline TCA-6 was indeed found by SYN87-SB with its pseudo-nacelle approximation. Recent incorporation of a Navier-Stokes capability was prompted by the potential for application to the optimization of HSCT wing flap/slat settings. The gridding is ready, but viscous flow calculations are still not an option in SYN87-SB at the time of writing. Indeed, it is not clear that such a capability is practical in view of the large memory requirements and limited potential for distributed processing (limited to autotasking on CRAY C90-class supercomputers). Nonetheless, automated Navier-Stokes gridding for any likely wing/body configuration represents a potentially valuable capability which, at least, can be used in conjunction with the FLO107-MB multiblock solver. This solver has produced the only calculations on these grids so far. Proper validation of the calculations remains a loose end, but flow solver convergence provides a certain measure of grid quality, and no surprises were encountered in these initial viscous solutions.
Author
Body-Wing Configurations; Computational Grids; Grid Generation (Mathematics); Navier-Stokes Equation; Euler Equations of Motion; Applications Programs (Computers); Computational Fluid Dynamics

20000014382 NASA Ames Research Center, Moffett Field, CA USA
Nacelle/Diverter Integration into the Design Optimization Process Using Pseudo, Warped, and Real Nacelles
Cliff, Susan E., NASA Ames Research Center, USA; Reuther, James J., MCAT Inst., USA; Saunders, David A., Raytheon STX Corp., USA; Rimlinger, Mark J., Raytheon STX Corp., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 685-746; In English; See also 20000014369; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

The computational results of the optimized complete configurations, including nacelles and diverters, are presented in terms of drag count improvement compared with the TCA baseline configuration at Mach 2.4, C(sub L)=0.1. The three candidate designs are designated by the organization from which they were derived. ARC represents the Ames Research Center 1-03 design, BCAG represents the Boeing Commercial Aircraft Group's design from Seattle, and BLB represents the design from Boeing Long Beach. All CFD methods are in unanimous agreement that the Ames 1-03 configuration has the largest performance improvement, followed closely by the BCAG configuration, with a much smaller improvement attained by Boeing Long Beach. The Ames design was obtained using the single-block wing/body code SYN87-SB with its "pseudo" nacelle option-an elaborate technique for incorporating nacelle/diverter effects into the design optimization process. This technique uses AIRPLANE surface pressure coefficient data with and without the nacelles/diverters. Further details of this method are described. It is reasonable to expect that further improvements could be achieved by including the "real" nacelles directly into the optimization process by use of the newly-developed multiblock optimization code, SYN107-MB, which can handle full configurations.
Derived from text
Computational Fluid Dynamics; Engine Airframe Integration; Design Analysis; Multiblock Grids; Body-Wing Configurations; Aircraft Design; Applications Programs (Computers)

20000014383 NASA Langley Research Center, Hampton, VA USA
A PTC Optimization and Control Surface Interference Study HSR Airframe Technical Review
Hicks, Raymond; Cliff, Susan; Rimlinger, Mark; Murman, Scott; Reuther, James; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 747-800; In English; See also 20000014369; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

This report considers the effect of canard and horizontal tail vertical position on the aerodynamic characteristics of the PTC configuration without nacelles and diverters. This analysis is followed by three optimization studies using canard and tail incidence as design variables in the first problem followed by an optimization run with canard and tail incidence and wing camber design variables and finally an optimization run with canard incidence and wing camber. The first problem was run at fixed lift while the other two problems were run at fixed angle of attack. The final investigation reported here will show data from a

component buildup study using the PTC configuration. This final study will show the aerodynamic interference between the canard, wing and horizontal tail.
Author
Canard Configurations; Aircraft Design; Optimization; Aerodynamic Interference; Horizontal Tail Surfaces; Aerodynamic Characteristics

20000014384 NASA Ames Research Center, Moffett Field, CA USA
Multi-Configuration and Aeroelastic Shape Design
Reuther, James, MCAT Inst., USA; Alonso, Juan J., Stanford Univ., USA; Smith, Steve, NASA Ames Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 801-864; In English; See also 20000014369; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

This presentation describes the advances being made with the Aerodynamic Shape Optimization (ASO) and high-fidelity Multidisciplinary Optimization (MDO) software used in the High Speed Research Program at NASA Ames Research Center. The description starts with the motivation for continued ASO/MDO development. Objectives of the current work are then presented. A list of ingredients deemed necessary for a flexible design environment is discussed, and the HSR requirement for different geometries at different design points is explained. Multiple design disciplines within a high-fidelity design environment are demonstrated. Finally, progress so far is summarized and planned future work is outlined.
Author
Multidisciplinary Design Optimization; Aircraft Design; Design Analysis

20000017940 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
A Comprehensive Approach to Teaching Avionics Systems Flight Test
Lucka, Doug; Michael, Bill; Mar. 18, 1999; 40p; In English
Report No.(s): AD-A368650; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Comprehensive Approach to Teaching Avionics Systems Flight Test
DTIC
Avionics; Education; Flight Tests; Navy

20000018027 NASA Langley Research Center, Hampton, VA USA
Active Control of Flow Separation Over an Airfoil
Ravindran, S. S., National Academy of Sciences - National Research Council, USA; December 1999; 14p; In English
Contract(s)/Grant(s): NASw-8154; RTOP 706-32-21-02
Report No.(s): NASA/TM-1999-209838; NAS 1.15:209838; L-17932; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Designing an aircraft without conventional control surfaces is of interest to aerospace community. In this direction, smart actuator devices such as synthetic jets have been proposed to provide aircraft maneuverability instead of control surfaces. In this article, a numerical study is performed to investigate the effects of unsteady suction and blowing on airfoils. The unsteady suction and blowing is introduced at the leading edge of the airfoil in the form of tangential jet. Numerical solutions are obtained using Reynolds-Averaged viscous compressible Navier-Stokes equations. Unsteady suction and blowing is investigated as a means of separation control to obtain lift on airfoils. The effect of blowing coefficients on lift and drag is investigated. The numerical simulations are compared with experiments from the Tel-Aviv University (TAU). These results indicate that unsteady suction and blowing can be used as a means of separation control to generate lift on airfoils.
Author
Active Control; Airfoils; Navier-Stokes Equation; Mathematical Models; Algorithms; Computational Fluid Dynamics; Separated Flow; Unsteady Aerodynamics

20000019624 Naval Surface Warfare Center, Dahlgren Div., Dahlgren, VA USA
Refinements in the Aeroprediction Code Based on Recent Wind Tunnel Data *Final Report*
Moore, Frank G.; McInville, Roy M.; Dec. 1999; 130p; In English
Report No.(s): AD-A371025; NSWCDD/TR-99/116; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The 1998 (AP98) and prior versions of the aeroprediction code are based primarily on slender body and perturbation theories at low angle of attack and empirical constants that represent the nonlinear aerodynamics as a function of angle of attack, Mach number, aspect and taper ratio, and other missile geometric parameters. The primary data base upon which these empirical nonlinear constants were derived was based on the NASA/Tri-Service component data base taken in the 1970s. This data base

was limited in body radius to wing semispan plus body radius ratios (r/s) of 0.5. A more recent data base taken by NASA and the former McDonnell Douglas Corporation, investigated other values of the parameter r/s of 0.25, 0.33 and 0.5. As a result of this new data base, the empirical constants in the AP98 were fine-tuned. This fine-tuning has shown the average normal force coefficient errors to be reduced by anywhere from 10 percent to over 40 percent on various missile configurations. The largest reductions in error were for configurations where the AP98 average accuracy was the worst. These new improved empirical constants will be a part of the next planned release of the aeroprediction code in 2002 (AP02). The AP98 average error on normal force coefficient of +/- 10 percent will therefore be somewhat better for the AP02.
DTIC
Body-Wing Configurations; Aerodynamics; Slender Bodies; Computer Aided Design; Wind Tunnel Tests; Aerodynamic Configurations; Missile Configurations; Perturbation

20000019642 Federal Aviation Administration, John A. Volpe National Transportation Systems Center, Cambridge, MA USA
Wind Effects on the Lateral Motion of Wake Vortices ***Final Report, Jan. 1975 - Dec. 1984***
Burnham, David C., Scientific and Engineering Solutions, Inc., USA; Hallock, James N., Federal Aviation Administration, USA; November 1999; 72p; In English
Contract(s)/Grant(s): FA927/A9433
Report No.(s): PB2000-101057; DOT-VNTSC-FAA-99-14; DOT/FAA/AAR-99/88; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This report examines the influence of crosswind and other factors on the behavior of wake vortices. Data from acoustic remote sensors and in situ sensors were used to track the possible transfer if wake vortices between parallel runways. The measurements used in the analysis came from landing (1976-7) and takeoff (1980) operations at O'Hare International Airport. As expected, wake vortices are observed to transport with the ambient wind, therefore, dangerous wake vortex encounters can be avoided on parallel runways with suitable assignment of aircraft to the two runways. The analyses of the report were carried out in the mid 1980s and serve to document the O'Hare landing and takeoff databases and how they can be used. The status of the acoustic and in situ wake vortex sensors is updated to the late 1990s.
NTIS
Wind Effects; Wind Direction; Wakes; Vortices

20000020876 NASA Langley Research Center, Hampton, VA USA
1999 NASA High-Speed Research Performance Workshop, Volume 1, Configuration Aerodynamics
Hahne, David E., Editor, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; 792p; In English; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, 8-12 Feb. 1999, Anaheim, CA, USA; See also 20000020877 through 20000020887
Contract(s)/Grant(s): RTOP 537-07-51-10
Report No.(s): NASA/CP-1999-209704/VOL1/PT2; L-17911B; NAS 1.55:209704/VOL1/PT2; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

NASA's High-Speed Research Program sponsored the 1999 Aerodynamic Performance Technical Review on February 8-12, 1999 in Anaheim, California. The review was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in the areas of Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High Lift, and Flight Controls. The review objectives were to (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientists and engineers working on HSCT aerodynamics. In particular, single and midpoint optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT simulation results were presented, along with executive summaries for all the Aerodynamic Performance technology areas. The HSR Aerodynamic Performance Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration. Thus, a fourth objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas of the HSR Program. This Volume 1/Part 2 publication covers the design optimization and testing sessions.
Author
Aerodynamic Configurations; Computational Fluid Dynamics; Supersonic Transports; Wind Tunnel Tests; Optimization; Aircraft Design

20000020877 Boeing Commercial Airplane Co., Seattle, WA USA

Progress Toward Single and Multi-Point Optimization Tool Realization

Conner, R. S., Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 901-994; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

This presentation covers the progress made during the last year on single and multi-point optimization at BCAG. The highest level goal guiding this work is to accomplish an evaluation of the benefits of nonlinear multi-point optimization. This is not seen as a final answer to the question, but rather just the start. There are many variations on the application of multi-point techniques to the HSCT design problem. The efforts represented here are aimed at the completion of the basic problem that has evolved from many years of linear design efforts. More details of the target evaluation are given in the conclusion of the presentation. Point design technology is not fully mature. As the enabling technology upon which multi-point is built, improved point design is the next highest goal of this work.

Derived from text

Design Analysis; Aircraft Design; Optimization; Aerodynamic Characteristics

20000020878 Boeing Co., Long Beach, CA USA

Design Cycle-Time Reduction Using TLNS3D-Adjoint

Kuruvila, Geojoe, Boeing Co., USA; Narducci, Robert P., Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 995-1048; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Significant cycle-time reduction has been achieved by using the TLNS3D-Adjoint code for the aerodynamic shape optimization of High Speed Civil Transport (HSCT) configurations. Using the adjoint of TLNS3D (Euler) flow analysis code, aerodynamic gradients are computed, both accurately and efficiently, for hundreds of design variables. Results obtained by using TLNS3D-Adjoint in the aerodynamic shape optimization of HSCT Technology Concept Airplane (TCA) configurations are presented.

Derived from text

Aircraft Design; Aircraft Configurations; Design Analysis; Applications Programs (Computers); Optimization

20000020879 Boeing Co., Long Beach, CA USA

Progress Towards Viscous Design Optimization Using Automatic Differentiation

Sundaram, P., Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1049-1110; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Background Design cycle time in a nonlinear shape optimization process is mainly dependent on the time taken for the objective function sensitivity calculation. Considerable effort has been spent in the past few years to develop efficient techniques for calculating the sensitivities. Primary among them is the method of deriving the adjoints by posing the original continuous form of the problem as a calculus of variation problem. This requires long and tedious analytical derivations and hand-differentiation of the underlying partial differential equations. The adjoint variables for the Euler equations already derived and codes based on this are available. For Navier-Stokes equations, the theory of adjoints is much more complicated and becomes almost intractable. More so, for different turbulence models the hand-differentiation method of adjoints is impractical. The ADIFOR-based methods, on the other hand, are straight-forward and are applied directly to the differential form of the equations of motion already available in the form of FORTRAN codes. The resulting computer-generated differentiated form of the existing function computer codes provide accurate analytical sensitivities. Also, the ADIFOR and ADJIFOR application procedures are the same for both the Euler and Navier-Stokes codes. Thus, it can be seen that the automated procedure for generating adjoint codes using ADJIFOR has several advantages over the hand-differentiated adjoint codes.

Derived from text

Adjoints; Optimization; Differentiators; Applications Programs (Computers); Aircraft Design; FORTRAN

20000020880 Boeing Co., Long Beach, CA USA

Technology Development for a Multipoint Optimization Process for an HSCT

Narducci, Robert, Boeing Co., USA; Hager, James, Boeing Co., USA; Unger, Eric, Boeing Co., USA; Kuruvila, Geojoe, Boeing Co., USA; Sundaram, P., Boeing Co., USA; Hartwich, Peter, Boeing Co., USA; Martin, Grant, Boeing Co., USA; Mendoza, Raul, Boeing Co., USA; Arslan, Alan, Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1111-1162; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Previous non-linear aerodynamic optimization work has focused mainly on the most important leg of the HSCT mission, the supersonic cruise. The benefits of this single-point optimization has not yet been fully realized and it is possible that with further work the goals of the HSR program may be met. However, consideration of the supersonic cruise performance may not be adequate to obtain a truly optimized HSCT since the airplane flies through diverse flowfields to accomplish each leg of its mission. Much of the technology development in 1998 has been to increase the fidelity of the analysis model, increase the number of degrees-of-freedom of the design, and reduce the cost of optimization. While these elements oppose each other, they are critical for a practical and successful multipoint optimization process. This paper begins by assessing the progress of nonlinear aerodynamic shape optimization towards meeting program goals set for the Technology Concept Airplane (TCA). This section establishes that program goals have not been met and that steps towards reaching these goals may be made through a multipoint approach. The next section defines two approaches for multipoint optimization. The first involves a series of single-point optimizations where the OML is defined by supersonic cruise considerations, and flap schedules are determined in subsequent optimizations at off-design Mach numbers. The second approach involves concurrent assessments of the design performance at all critical Mach numbers. The next section documents the optimization technology development in 1998. This includes enhancements to grid generation, configuration modeling, flow analysis, gradient calculations, and design variable definitions. Intermediate results that demonstrate these technologies conclude this paper.
Author
Supersonic Transports; Aircraft Design; Optimization; Aerodynamic Configurations

20000020881 NASA Ames Research Center, Moffett Field, CA USA
Accounting for Laminar Run & Trip Drag in Supersonic Cruise Performance Testing
Goodsell, Aga M., NASA Ames Research Center, USA; Kennelly, Robert A., NASA Ames Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1163-1196; In English; See also 20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

An improved laminar run and trip drag correction methodology for supersonic cruise performance testing was derived. This method required more careful analysis of the flow visualization images which revealed delayed transition particularly on the inboard upper surface, even for the largest trip disks. In addition, a new code was developed to estimate the laminar run correction. Once the data were corrected for laminar run, the correct approach to the analysis of the trip drag became evident. Although the data originally appeared confusing, the corrected data are consistent with previous results. Furthermore, the modified approach, which was described in this presentation, extends prior historical work by taking into account the delayed transition caused by the blunt leading edges.
Derived from text
Flow Visualization; Aerodynamic Drag; Boundary Layer Transition; Supersonic Drag; Aircraft Design; Laminar Boundary Layer

20000020882 NASA Ames Research Center, Moffett Field, CA USA
NCV Flow Diagnostic Test Results
Cappuccio, Mina, NASA Ames Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1197-1288; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

There were two objectives for this test. First, was to assess the reasons why there is approximately 1.5 drag counts (cts) discrepancy between measured and computed drag improvement of the Non-linear Cruise Validation (NCV) over the Technology Concept Airplane (TCA) wing body (WB) configurations. The Navier-Stokes (N-S) pre-test predictions from Boeing Commercial Airplane Group (BCAG) show 4.5 drag cts of improvement for NCV over TCA at a lift coefficient (CL) of 0. I at Mach 2.4. The pre-test predictions from Boeing Phantom Works - Long Beach, BPW-LB, show 3.75 drag cts of improvement. BCAG used OVERFLOW and BPW-LB used CFL3D. The first test entry to validate the improvement was held at the NASA Langley Research Center (LARC) UPV;T, test number 1687. The experimental results showed that the drag improvement was only 2.6 cts, not accounting for laminar run and trip drag. This is approximately 1.5 cts less than predicted computationally. In addition to the low Reynolds Number (RN) test, there was a high RN test in the Boeing Supersonic Wind Tunnel (BSWT) of NCV and TCA. BSV@T test 647 showed that the drag improvement of NCV over TCA was also 2.6 cts, but this did account for laminar run and trip drag. Every effort needed to be done to assess if the improvement measured in LaRC UPWT and BSWT was correct. The second objective, once the first objective was met, was to assess the performance increment of NCV over TCA accounting for the associated laminar run and trip drag corrections in LaRC UPWT. We know that the configurations tested have laminar flow on

portions of the wing and have trip drag due to the mechanisms used to force the flow to go from laminar to turbulent aft of the transition location.
Derived from text
Body-Wing Configurations; Aircraft Design; Supersonic Flow; Flow Measurement; Aerodynamic Characteristics; Aerodynamic Configurations

20000020883 NASA Langley Research Center, Hampton, VA USA
Aft Body Closure: Predicted Strut Effects at M=2.4
Lamar, John E., NASA Langley Research Center, USA; Garritz, Javier A., Vigyan Research Associates, Inc., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1473-1512; In English; See also 20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper reports the predicted M = 2.4 strut-interference effects on a closed aftbody with empennage for the TCA baseline model. The strut mounting technique was needed in order to assess the impact of aft-end shaping, i.e. open for a sting or closed to better represent a flight vehicle. However,this technique can potentially lead to unanticipated effects that are measured on the aft body. Therefore, a set of computations were performed in order to examine the closed aft body with and without strut present, at both zero and non-zero angles of sideslip (AOS). The work was divided into a computational task performed by Javier A. Garriz, using an inviscid (Euler) solver, and a monitoring/reporting task done by John E. Lamar. All this work was performed during FY98 at the NASA Langley Research Center.
Author
Afterbodies; Struts; Aircraft Design; Supersonic Transports; Aerodynamic Interference

20000020884 Boeing Co., Long Beach, CA USA
Flowfield Studies for the TCA/NCV Configurations
Mendoza, Raul, Boeing Co., USA; Shieh, Chih Fang, Boeing Co., USA; Sundaram, P., Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1289-1364; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

The Technology Concept Airplane (TCA) was developed using linear design and analysis methods. Ames Research Center (ARC), the Boeing Commercial Airplanes Group (BCAG), and Boeing Phantom Works (BPW) at Long Beach performed non-linear aerodynamic shape optimization to improve the supersonic cruise performance of the TCA. The three participating sites cross-checked the final designs using Euler and Navier-Stokes analyses of the wing/body (W/B) and wing/body/nacelle/diverter (W/B/N/D) configurations. The three optimized designs differed from each other, but all were shown to improve performance. Nevertheless, only the configuration that exhibited the best performance improvement over the TCA was selected for experimental validation and became known as the Non-linear Cruise point Validation (NCV) design. However, wind-tunnel data did not match the predicted performance of the NCV W/B design. Navier-Stokes computations had shown an expected drag benefit for the NCV W/B configuration on the order of 4 to 4.5 counts over the TCA W/B at cruise conditions; but the improvement measured in the wind tunnel was on the order of only 2 to 2.5 counts. Even though the experimental drag reduction for the W/B/N/D configuration was also smaller than expected, the measured drag benefit associated with the addition of nacelles was considered to have matched the CFD predictions within the scatter of the data. Therefore, this paper will concentrate on the W/B configurations.
Derived from text
Flow Distribution; Body-Wing Configurations; Supersonic Transports; Computational Fluid Dynamics; Wing Nacelle Configurations; Optimization; Drag Reduction

20000020885 NASA Langley Research Center, Hampton, VA USA
Supersonic Aftbody Closure Wind-Tunnel Testing, Data Analysis, and Computational Results
Allen, Jerry, NASA Langley Research Center, USA; Martin, Grant, Boeing Co., USA; Kubiatko, Paul, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1365-1472; In English; See also 20000020876; No Copyright; Avail: CASI; A06, Hardcopy; A10, Microfiche

This paper reports on the model, test, and results from the Langley Supersonic Aftbody Closure wind tunnel test. This project is an experimental evaluation of the 1.5% Technology Concept Aircraft (TCA) aftbody closure model (Model 23) in the Langley Unitary Plan Wind Tunnel. The baseline TCA design is the result of a multidisciplinary, multipoint optimization process and was developed using linear design and analysis methods, supplemented with Euler and Navier-Stokes numerical methods. After a thorough design review, it was decided to use an upswept blade attached to the forebody as the mounting system. Structural concerns dictated that a wingtip support system would not be feasible. Only the aftbody part of the model is metric. The metric

break was chosen to be at the fuselage station where prior aft-sting supported models had been truncated. Model 23 is thus a modified version of Model 20. The wing strongback, flap parts, and nacelles from Model 20 were used, whereas new aftbodies, a common forebody, and some new tails were fabricated. In summary, significant differences in longitudinal and direction stability and control characteristics between the ABF and ABB aftbody geometries were measured. Correcting the experimental data obtained for the TCA configuration with the flared aftbody to the representative of the baseline TCA closed aftbody will result in a significant reduction in longitudinal stability, a moderate reduction in stabilizer effectiveness and directional stability, and a moderate to significant reduction in rudder effectiveness. These reductions in the stability and control effectiveness levels of the baseline TCA closed aftbody are attributed to the reduction in carry-over area.
Derived from text
Wind Tunnel Tests; Wind Tunnel Models; Afterbodies; Supersonic Transports; Aircraft Stability; Aircraft Control

20000020886 Boeing Co., Long Beach, CA USA
Thrust Drag Bookkeeping and the Calibration of Nacelles for Internal Drag
Adamson, Eric, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1513-1642; In English; See also 20000020876; No Copyright; Avail: CASI; A07, Hardcopy; A10, Microfiche

The task of developing an internal drag calibration process for HSCT nacelles falls under the category of wind tunnel corrections. For the most part, however, it has been funded out of the Propulsion Induced Effects (PIE) Program. This interesting funding arrangement makes sense because a HSCT nacelle calibration process is a critical requirement for any PIE testing. As the HSCT program has evolved, accurate experimental assessments of nacelle integration effects have become more critical, and nacelle internal geometries have become more complex. As a result, it was apparent that the program had outgrown the empirical nacelle internal skin friction corrections of the past. In the case of M=2.4 cruise point experimental evaluation, the cost and accuracy of CFD based corrections may be sufficient to meet the programs internal drag correction needs. For off-design evaluations, the nacelle internal geometry becomes more complex (ramps & plugs), the number of required CFD runs increase, and convergence time and uncertainty increase. All this adds up to a cost for CFD based corrections that is currently unacceptable. Consequently, the preferred approach taken by most major transport or fighter programs is to calibrate nacelles. Historically, nacelle calibration has been shown to be a reliable, accurate, and cost effective approach to determining nacelle internal forces. Unfortunately, because of several unique features in current HSCT geometries and the thrust-drag bookkeeping system, the program could not adopt ”as-is” an existing calibration procedure from one of these programs. This report documents the results of two tests that were run in the Boeing Flight Simulation Chamber (FSC) to develop an HSCT specific calibration process. The report is divided into 6 parts. The first part is a review of thrust-drag accounting systems. The choice of how internal drag can be obtained is determined by the T-D system. The second part reviews the basic principles concerning how and why calibration works. The third and fourth part review results of the first HSCT calibration test. This test went a long way toward validating a HSCT methodology. The fifth and sixth parts review the results of the second calibration test. This test was intended to use some available hardware to refine the handling of Reynolds number effects and to explore the feasibility of calibrating with supersonic duct flow.
Derived from text
Aerodynamic Drag; Nacelles; Calibrating; Supersonic Transports; Ducted Flow; Wind Tunnel Tests

20000020887 MCAT Inst., Moffett Field, CA USA
Geometry-Driven Mesh Deformation
Reuther, James, MCAT Inst., USA; Rimlinger, Mark J., Raytheon, USA; Saunders, David, Raytheon, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 867-900; In English; See also 20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

At each design step during the application of an aerodynamic shape optimization method, it must be possible to obtain a mesh representing the current design changes and the gradients of the cost function. In an adjoint based method, the determination of changes in the cost function require that the variation in the mesh metrics be computed. Since it would be difficult to obtain an explicit relationship between arbitrary surface changes and variations in mesh metrics for complex configurations, these quantities are calculated through finite differences. This requires the mesh to be regenerated a number of times proportional to the number of design variables. The use of hyperbolic or elliptic iterative mesh generation techniques to construct a mesh for a single design variable perturbation becomes computationally prohibitive and may approach the cost of a flow solution. Additionally, no automated method exists for generating multiblock meshes about complex co three-dimensional configurations. Here, these difficulties are overcome through the use of a mesh perturbation technique. In this approach, a high quality mesh appropriate for the flow solver is first generated by any available procedure prior to the start of the design. This initial mesh becomes the basis for all subsequent meshes which are obtained by analytic perturbations. Applications for a mesh perturbation scheme can be found

in any area which wishes to take advantage of an existing mesh in order to avoid the laborious and time intensive process of regenerating a grid system. Rapid mesh morphing permits the reuse of existing mesh topologies on similar configurations as well as analysis and design accounting for static aeroelastics.
Derived from text
Computational Grids; Grid Generation (Mathematics); Aerodynamic Configurations; Aircraft Design; Optimization

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft 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.

20000019598 National Center for Atmospheric Research, Boulder, CO USA
Results of Holdover Time Testing of Type IV Anti-Icing Fluids with the Improved NCAR Artificial Snow Generation System *Final Report*
Rasmussen, R. M.; Hills, A.; Landolt, S.; Knight, C.; Dec. 1999; 50p; In English
Report No.(s): PB2000-102380; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report discusses improvements to the National Center for Atmospheric Research (NCAR) artificial snow generation machine and the results of anti-icing fluid testing with the improved machine. The improvements include (1) improved control of snowfall rate, (2) development of an integrated frosticator plate/snow mass measuring system, (3) automatic control and recording of the experiment, and (4) direct control of the frosticator plate temperature through an area heater controlled by an interface unit. This improved machine was used to conduct anti-icing fluid holdover time tests on several Type IV fluids. The results showed the typical inverse relationship between holdover time and snowfall rate. Tests with varying snowfall rates showed a factor of 1.5 to 2.0 longer holdover time for nonconstant snowfall rates. This result suggests that natural snow conditions are not as severe as the constant snowfall rate conditions tested in the laboratory. Causes for the longer holdover time were suggested to be (1) the longer time available for the absorption of the melted snow water, and (2) the warmer temperatures experienced during the time varying rate tests as compared to the constant rate tests.
NTIS
Deicers; Antiicing Additives; Aircraft Icing; Ice Prevention; Snow

20000019644 National Transportation Safety Board, Washington, DC USA
National Transportation Safety Board Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued during the Month of October 1999
Oct. 1999; 194p
Report No.(s): PB99-916710; NTSB/IDBOO-99/10; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche
This publication contains all Judges Initial Decisions and Board Opinions and Orders in Safety and Seaman Enforcement Cases for October 1999.
NTIS
Air Transportation; Safety Management; Accident Prevention

20000019677 Federal Aviation Administration, Washington, DC USA
Notices to Airmen, Domestic/International, October 7, 1999
Oct. 07, 1999; 256p; In English
Report No.(s): PB2000-101822; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche
Contents include the following: Airway Notams; Airports, Facilities and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum En Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.
NTIS
National Airspace System; Air Navigation; Charts; Runways; Airports; Air Traffic Control; Approach Control

20000020783 Naval Postgraduate School, Monterey, CA USA
Aircraft Survivability 1999. Challenges for the New Millennium
Nov. 18, 1999; 45p; In English
Report No.(s): AD-A371753; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents abstracts on Aircraft Survivability in 1999. Some of the topics include: 1) CM (Countermeasures) What Works, What Doesn't; 2) Defeating The Threat At Low Altitude; 3) Spacecraft-A New Frontier for Aerospace Survivability; 4) U.S. Marine Corps Requirements For Aircrfaft Survivability; 5) MANPADS: The Vulnerability Challenge. This paper also includes poster abstracts.
CASI
Abstracts; Aircraft Survivability

20000020962 Massachusetts Inst. of Tech., Lincoln Lab., Cambridge, MA USA
Lincoln Laboratory Evaluation of TCAS II Logic, Volume 1, 7
Chludzinski, B. J.; Dec. 13, 1999; 88p; In English
Report No.(s): PB2000-102388; ATC-268-V1; No Copyright; Avail: Issuing Activity

This report documents the Lincoln Laboratory evaluation of the Traffic Alert and Collision Avoidance System II (TCAS II) logic version 7. TCAS II is an airbone collision avoidance system required since 30 December 1993 by the FAA on all air carrier aircraft with more than 30 passenger seats operating in the U.S. airspace. Version 7 is a major revision to the TCAS II logic consisting of more than 300 separately defined changes affecting all major TCAS areas (surveillance, CAS logic and displays/aurals). Lincoln Laboratory evaluated the logic by examining approximately two million simulated pairwise TCAS-TCAS encounters, derived from actual tracks recorded in U.S. airspace. The main goals of the evaluation were: (1) to study the performance of the new TCAS-TCAS coordinated reveral logic; (2) to detect and explain any areas of poor performance; (3) to examine the performance of the version 7 logic for the 30 Representative NMACs identified during the 6.04a logic evaluation; and (4) to understand the limitations of the logic by analyzing every version 7 NMAC.
NTIS
Aircraft Instruments; Flight Paths; Software Engineering; Collision Avoidance; Warning Systems

20000020963 Massachusetts Inst. of Tech., Lincoln Lab., Cambridge, MA USA
Lincoln Laboratory Evaluation of TCAS II Logic, Volume 2, Appendices, 7
Chludzinski, B. J.; Dec. 13, 1999; 320p; In English
Report No.(s): PB2000-102389; ATC-268-V2; No Copyright; Avail: Issuing Activity

This volume presents tables and figures that were generated during the assessment to the TCAS Logic Performance.
NTIS
Aircraft Instruments; Flight Paths; Logic

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.

20000017923 Massachusetts Inst. of Tech., International Center for Air Transportation, Cambridge, MA USA
Implementation Issues for Departure Planning Systems
Hansman, R. John, Massachusetts Inst. of Tech., USA; Feron, Eric, Massachusetts Inst. of Tech., USA; Clarke, John-Paul, Massachusetts Inst. of Tech., USA; Odoni, Amedeo, Massachusetts Inst. of Tech., USA; [1999]; 95p; In English
Contract(s)/Grant(s): NCC2-1147; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The objective of the proposed effort is to investigate issues associated with the design and implementation of decision aiding tools to assist in improving the departure process at congested airports. This effort follows a preliminary investigation of potential Departure Planning approaches and strategies, which identified potential benefits in departure efficiency, and also in reducing the environmental impact of aircraft in the departure queue. The preliminary study bas based, in large part, on observations and analysis of departure processes at Boston, Logan airport. The objective of this follow-on effort is to address key implementation issues and to expand the observational base to include airports with different constraints and traffic demand. Specifically, the objectives of this research are to: (1) Expand the observational base to include airports with different underlying operational

dynamics. (2) Develop prototype decision aiding algorithms/approaches and assess potential benefits. and (3) Investigate Human Machine Integration (HMI) issues associated with decision aids in tower environments.
Author
Research; Decision Support Systems; Traffic; Airports

20000019631 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
GPS Performance in Navigation
Misra, Pratap, Massachusetts Inst. of Tech., USA; Burke, Brian P., Massachusetts Inst. of Tech., USA; Pratt, Michael M., Massachusetts Inst. of Tech., USA; Proceedings of the IEEE; January 1999; ISSN 0018-9219; Volume 87, No. 1, pp. 65-85; In English
Contract(s)/Grant(s): F19628-95-C-0002
Report No.(s): AD-A366434; JA-7620; esc-tr-98-047; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

We discuss Global Positioning System (GPS) measurements available for civil use and algorithms for processing them to obtain real time estimates of position and velocity. The main objective it to characterize the measurements and to demonstrate the levels of performance achievable with a single GPS receiver and with system augmentations which make corrections to the measurements available to the user in real time. Representative results with positioning accuracy levels ranging from tens of meters to centimeters are given based on actual measurements.
Author
Global Positioning System; Satellite Navigation Systems; Mathematical Models; Performance Prediction

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.

20000014372 Boeing Commercial Airplane Co., Seattle, WA USA
Nacelle/Diverter Design and Airframe Integration
Chaney, Steve, Boeing Commercial Airplane Co., USA; Wittenberg, Robyn, Boeing Commercial Airplane Co., USA; Malone, Mike, Northrop Grumman Corp., USA; Speer, Steven, Northrop Grumman Corp., USA; Dimanlig, Arsenio, Northrop Grumman Corp., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 67-212; In English; See also 20000014369; No Copyright; Avail: CASI; A07, Hardcopy; A10, Microfiche

This report documents the propulsion/airframe integration (PAI) and propulsion induced effects (PIE) analyses performed by Boeing Commercial Airplane (BCA) in Seattle, and subcontractor Northrop-Grumman Corporation (NGC). After the objective and approach are discussed the report is broken down into two main sections. The supercruise studies focussed on various configuration issues regarding installation of the bifurcated inlet, and analysis of bleed door and flow effects on external aerodynamics. The transonic cruise and climb studies were focussed on spillage and bypass effects.
Derived from text
Engine Airframe Integration; Inlet Airframe Configurations; Nacelles; Diverters; Supersonic Nozzles; Transonic Nozzles; Aerodynamic Characteristics; Inlet Nozzles; Nozzle Design

20000019599 SRI International Corp., Menlo Park, CA USA
Full-Scale Tests of Lightweight Fragment Barriers on Commercial Aircraft ***Final Report, 30 Dec. 1998 - 30 Jun. 1999***
Shockey, D. A., SRI International Corp., USA; Erlich, D. C., SRI International Corp., USA; Simons, J. W., SRI International Corp., USA; Nov. 1999; 24p; In English
Contract(s)/Grant(s): 95-G-010
Report No.(s): PB2000-102379; SRI-7412; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

SRI International is evaluating the ballistic effectiveness of fabric structures made from advanced polymers and developing a computational ability to design fragment barriers. In this reporting period, SRI performed full-scale fabric barrier tests on an aircraft fuselage at the Navy Air Warfare Center in China Lake, CA. The tests examined the effects of polymer material, number of plies, location of the fabric within the fuselage wall, and gripping arrangements. The results were very encouraging. For example, three piles of polybenzoxazole (PBO) Zylon woven fabric glued to the outboard side of the insulation packet and

weighing only 0.05 g/sq cm (0.1 lb/sq ft) prevented a 166-g (0.37-lb) sharp-edged fan blade fragment impacting edge-on at 230 m/s (756 ft/s) from penetrating into the cabin. The absorbed energy of 4400 joules (3250 ft-lb) is nearly an order of magnitude greater than that absorbed by the unfortified fuselage wall. The results confirmed that high-strength polymer fabrics offer an extremely effective, low-weight solution for mitigating the effects of uncontained turbine engine fragments on commercial aircraft.
NTIS
Fragments; Barriers; Ballistics; Full Scale Tests; Turbine Engines

20000021013 Department of Defense, Office of Inspector General, Arlington, VA USA
C-17 Program Serialization of Airframe Fracture-Critical and Landing-Gear Reliability-Critical Parts
Mar. 24, 1999; 26p; In English
Contract(s)/Grant(s): Proj. 8AL-3002.00
Report No.(s): AD-A367044; IG/DOD-99-114; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
This report is the first in a series on the life-cycle management of military aircraft landing-gear parts. This report addresses the serialization and tracking of airframe fracture-critical and landing-gear reliability-critical parts for the C-17 aircraft. The audit objective was to evaluate the Air Force actions to serialize and provide part-tracking capability of C-17 airframe fracture-critical and landing-gear reliability-critical parts to facilitate life-cycle management. We also evaluated the effectiveness of the management control program as it applied to the audit objective.
DTIC
C-17 Aircraft; Airframes; Fracturing; Landing Gear; Structural Reliability

06
AVIONICS AND AIRCRAFT INSTRUMENTATION

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.

20000019589 Lockheed Martin Corp., Palmdale, CA USA
Design Description of the X-33 Avionics Architecture
Reichenfeld, Curtis J., AlliedSignal, Inc., USA; Jones, Paul G., AlliedSignal, Inc., USA; [1999]; 1p; In English; Aerospace, 18 Mar. 2000, Big Sky, MT, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): NCC8-115; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only
In this paper, we provide a design description of the X-33 avionics architecture. The X-33 is an autonomous Single Stage to Orbit (SSTO) launch vehicle currently being developed by Lockheed Martin for NASA as a technology demonstrator for the VentureStar Reusable Launch Vehicle (RLV). The X-33 avionics provides autonomous control of die vehicle throughout takeoff, ascent, descent, approach, landing, rollout, and vehicle safing. During flight the avionics provides communication to the range through uplinked commands and downlinked telemetry. During pre-launch and post-safing activities, the avionics provides interfaces to ground support consoles that perform vehicle flight preparations and maintenance. The X-33 Avionics is a hybrid of centralized and distributed processing elements connected by three dual redundant Mil-Std 1553 data buses. These data buses are controlled by a central processing suite located in the avionics bay and composed of triplex redundant Vehicle Mission Computers (VMCs). The VMCs integrate mission management, guidance, navigation, flight control, subsystem control and redundancy management functions. The vehicle sensors, effectors and subsystems are interfaced directly to the centralized VMCs as remote terminals or through dual redundant Data Interface Units (DIUs). The DIUs are located forward and aft of the avionics bay and provide signal conditioning, health monitoring, low level subsystem control and data interface functions. Each VMC is connected to all three redundant 1553 data buses for monitoring and provides a complete identical data set to the processing algorithms. This enables bus faults to be detected and reconfigured through a voted bus control configuration. Data is also shared between VMCs though a cross channel data link that is implemented in hardware and controlled by AlliedSignal's Fault Tolerant Executive (FTE). The FTE synchronizes processors within the VMC and synchronizes redundant VMCs to each other. The FTE provides an output-voting plane to detect, isolate and contain faults due to internal hardware or software faults and reconfigures the VMCs to accommodate these faults. Critical data in the 1553 messages are scheduled and synchronized to specific processing frames in order to minimize data latency. In order to achieve an open architecture, military and commercial off-the-shelf equipment is incorporated using common processors, standard VME backplanes and chassis, the VxWorks operating system, and

MartixX for automatic code generation. The use of off-the-shelf tools and equipment helps reduce development time and enables software reuse. The open architecture allows for technology insertion, while the distributed modular elements allow for expansion to increased redundancy levels to meet the higher reliability goals of future RLVs.
Author
X-33 Reusable Launch Vehicle; Single Stage to Orbit Vehicles; Venturestar Launch Vehicle; Spacecraft Design; Avionics

07
AIRCRAFT PROPULSION AND POWER

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

20000017928 NASA Glenn Research Center, Cleveland, OH USA
The Design of Future Airbreathing Engine Systems within an Intelligent Synthesis Environment
Malone, J. B., NASA Langley Research Center, USA; Housner, J. M., NASA Langley Research Center, USA; Lytle, J. K., NASA Glenn Research Center, USA; December 1999; 16p; In English; 14th; 14th International on Air Breathing Engines, 5-10 Sep. 1999, Florence, Italy; Sponsored by International Society for Air Breathing Engines, USA
Contract(s)/Grant(s): RTOP 509-10-11
Report No.(s): NASA/TM-1999-209192; NAS 1.15:209192; E-11706; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes a new Initiative proposed by the National Aeronautics and Space Administration (NASA). The purpose of this initiative is to develop a future design environment for engineering and science mission synthesis for use by NASA scientists and engineers. This new initiative is called the Intelligent Synthesis Environment (ISE). The paper describes the mission of NASA, future aerospace system characteristics, the current engineering design process, the ISE concept, and concludes with a description of possible ISE applications for the decision of air-breathing propulsion systems.
Author
Air Breathing Engines; Design Analysis; Aerospace Systems; Systems Engineering; NASA Programs

20000018016 NASA Glenn Research Center, Cleveland, OH USA
Wave-Rotor-Enhanced Gas Turbine Engine Demonstrator
Welch, Gerard E., Army Research Lab., USA; Paxson, Daniel E., NASA Glenn Research Center, USA; Wilson, Jack, DYNACS Engineering Co., Inc., USA; Synder, Philip H., Rolls-Royce Allison, USA; October 1999; 18p; In English; Gas Turbine Operation and Technology for Land, Sea and Air Propulsion and Power Systems, 18-21 Oct. 1999, Ottawa, Canada; Sponsored by Research and Technology Organization, France
Contract(s)/Grant(s): DA Proj. 1L1-62211-A4-7A; RTOP 523-26-33
Report No.(s): NASA/TM-1999-209459; NAS 1.15:209459; ARL-TR-2113; E-11958; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. Army Research Laboratory, NASA Glenn Research Center, and Rolls-Royce Allison are working collaboratively to demonstrate the benefits and viability of a wave-rotor-topped gas turbine engine. The self-cooled wave rotor is predicted to increase the engine overall pressure ratio and peak temperature by 300% and 25 to 30%. respectively, providing substantial improvements in engine efficiency and specific power. Such performance improvements would significantly reduce engine emissions and the fuel logistics trails of armed forces. Progress towards a planned demonstration of a wave-rotor-topped Rolls-Royce Allison model 250 engine has included completion of the preliminary design and layout of the engine, the aerodynamic design of the wave rotor component and prediction of its aerodynamic performance characteristics in on- and off-design operation and during transients, and the aerodynamic design of transition ducts between the wave rotor and the high pressure turbine. The topping cycle increases the burner entry temperature and poses a design challenge to be met in the development of the demonstrator engine.
Author
Wave Rotors; Gas Turbine Engines; Topping Cycle Engines; Engine Design; High Pressure; Turbines

20000019635 Institute for Defense Analyses, Alexandria, VA USA
MEMS in Turbine Engines ***Final Report, Jan. - Jul. 1998***
Seraphin, A. A., Institute for Defense Analyses, USA; Singer, R. A., Institute for Defense Analyses, USA; Frank, F. R., Institute for Defense Analyses, USA; Carson, K., Institute for Defense Analyses, USA; January 1999; 41p; In English
Contract(s)/Grant(s): DASW01-94-C-0054
Report No.(s): AD-A366509; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This document analyzes the use of micro-electromechanical systems (MEMS) in turbine engines. Potential applications of MEMS include sensor, actuator, power, and communication systems. In addition, there is significant analysis of technical and policy barriers to the transition of MEMS into engines. Briefing slides from a presentation on this topic delivered at an AIAA (American Institute of Aeronautics and Astronautics) Fluid Dynamics Conference are included as an appendix.
Author
Microelectromechanical Systems; Turbine Engines

20000020691 Department of Energy, Morgantown, WV USA
Overview of the DOE Advanced Turbine Systems Program
Layne, Abbie W., Department of Energy, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 29-53; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a general overview of the DOE (Department of Energy) advanced turbine system in viewgraph form. Advanced turbine systems are being developed because 1) gas turbine power systems markets are rapidly growing to serve new demand, displacement or existing capacity and replacement of retired capacity; 2) environmental regulations continue to require reduced levels of air pollutants from power generation facilities; and 3) DOE shares risk/accelerates public benefits.
CASI
Gas Turbines; Market Research; Regulations; Air Pollution

20000020692 NASA Glenn Research Center, Cleveland, OH USA
GAP Program Overview
Burkardt, Leo, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 55-77; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

NASA's General Aviation Propulsion (GAP) program is a cooperative program between government and industry. NASA's strategic direction is described by the "Three Pillars" and their Objectives as set forth by NASA Administrator Daniel S. Goldin. NASA's Three Pillars are: 1) Global Civil Aviation, 2) Revolutionary Technology Leaps, and 3) Access to Space.
Derived from text
General Overviews; Jet Propulsion; Civil Aviation; Gas Turbine Engines

20000020706 NASA Glenn Research Center, Cleveland, OH USA
Coupled, Transient Simulations of the Interaction Between Power and Secondary Flowpaths in Gas Turbines
Athavale, M. M., CFD Research Corp., USA; Przekwas, A. J., CFD Research Corp., USA; Li, H.-Y., CFD Research Corp., USA; Hendricks, Robert, NASA Glenn Research Center, USA; Steinetz, Bruce, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 309-343; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a coupled analysis of the interaction between mainpath and secondary flowpaths in gas turbines using transient simulations. Some of the topics include: 1) Need for Coupled Analysis; 2) Primary-Secondary Coupling Schematic; 3) Secondary Flow Requirement; 4) Objectives of Present Methodology; 5) Current Methodologies Recap; 6) Proposed Coupled Code Methodology; 7) Description of SCISEAL Code; 8) Description of Turbo Code; 9) Code Coupling/Interface Issues; and 10) Current Interface Strategy. This paper is presented in viewgraph form.
CASI
Secondary Flow; Gas Turbines; Computerized Simulation; Applications Programs (Computers); Coupled Modes

20000020707 NASA Glenn Research Center, Cleveland, OH USA
NPSS Engine Systems Simulations
Veres, Joseph P., NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 345-363; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents NPSS (Numerical Propulsion System Simulation) Engine Systems Simulations in viewgraph form. The topics include: 1) Multidisciplinary Design Optimization Using UG/WAVE; 2) Flow Solver for National Combustion Code; 3)

National Combustion Code Computing Framework; 4) National Combustion Code; 5) Low Pressure Subsystem 3-D Model; 6) Flow Simulation of the EEE (Energy Efficient Engine) Gas Turbine Low Pressure Subsystem; 7) Turbine Blade Tip and Outer Air Seal; and 8) Eng 20 Simulation of Turbofan Engine.
CASI
Computerized Simulation; Turbofan Engines; Propulsion System Performance; Combustion

20000020789 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Design Principles and Methods for Aircraft Gas Turbine Engines ***Les Principes et Methodes de Conception des Turbomoteurs***
Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999; 482p; In English; In French, 11-15 May 1998, Toulouse, France; See also 20000020790 through 20000020828; Original contains color illustrations
Report No.(s): RTO-MP-8; AC/323(AVT)TP/9; ISBN 92-837-0005-8; Copyright Waived; Avail: CASI; A21, Hardcopy; A04, Microfiche

The symposium dealt with design approaches for military aircraft propulsion systems to provide enhanced operational flexibility, longer range, better fuel efficiency and improved affordability. All classes of gas turbines were addressed in nine sessions as follows: Engine Design and Analysis (Part 1) (5 papers); Mechanical Systems (6 papers) Controls (4 papers); Combustors/Augmentors (4 papers); Compressor Systems (Part 1) (5 papers); Compressor Systems (Part 2) (3 papers); Turbines (Part 1) (5 papers); Turbines (Part 2) (4 papers); and Engine Design and Analysis (Part 2) (4 papers). These proceedings also include a Technical Evaluation Report and a Keynote address published in French and English.
Derived from text
Aircraft Engines; Gas Turbine Engines; Engine Parts; Conferences; Engine Design

20000020790 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA
The Gas Turbine Engine Conceptual Design Process: An Integrated Approach
Stricker, Jeffrey M., Air Force Research Lab., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 1-1 - 1-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The conceptual design process of gas turbine engines is complex, involving many engineering disciplines. Aerodynamics, thermodynamics, heat transfer, materials science, component design, and structural analysis are a few of the fields employed when down selecting an appropriate engine configuration. Because of the complexity involved, it is critical to have a process that narrows engine options without missing the ”optimum”. The following paper describes a typical process used at the conceptual design level. The various steps that will be described include propulsion requirements definition, engine cycle analysis, component design, flowpath/weight prediction, installation, and engine design influence on aircraft size and performance. The engine design process is not completely linear since the steps listed above are highly interdependent. A number of iterations are usually necessary in selecting a final engine configuration. This paper will describe several of the inter-relationships between the various steps. Frequently, a particular aircraft system has special requirements that influence the design selection process. Some modem day examples of these criteria include reduced observables and cost reduction. How these variations arc incorporated into the conceptual design process will be discussed.
Derived from text
Engine Design; Gas Turbine Engines; Structural Analysis; Thermodynamics; Weight Analysis

20000020791 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
Design of a New Fighter Engine: The Dream in an Engine Man’s Life
Schaeffler, A., Motoren- und Turbinen-Union G.m.b.H., Germany; Lauer, W., Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 2-1 - 2-7; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In 1984-85 a feasibility study between 5 European Nations France, Germany, Italy, Spain and UK for a common air superiority fighter was pursued which ended in 4 Nations to step into the Definition Phase in autumn 85. For us this was the beginning of an exciting experience in various roles as MTU Chief Engineers and Technical Directors of Eurojet Turbo GmbH, i.e. Chairmen of the Chief Engineers’ meeting. Designing a brand new fighter engine at the very edge of technology is an occasion so seldom that given the opportunity to take a lead function in such a multi-billion dollar project is a dream, which only few enjoy once a life.
Derived from text
Fighter Aircraft; Aircraft Engines; Design

20000020792 Rolls-Royce Ltd., Military Aero Engines, Bristol, UK

Designing for Reliability: The Rolls-Royce Approach

Hopper, P. J., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 3-1 - 3-5; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In today's highly competitive world market, where safety, reliability and operating costs of equipment are often paramount, there are many drivers to maintaining a viable, and economic operation. This is as true in the world of-aerospace as in any other. Aircraft on the ground neither win wars for armed forces nor earn revenue for civil operators. It is against this background that the Rolls-Royce Aerospace Group has as one of its primary objectives the "provision of reliable, and safe products and services which meet the expectations and specified requirements" of its various customers. These include both military and civil operators, and various regulatory authorities. The task of the Company is therefore to realise the challenge in meeting these safety and reliability requirements in both the civil and military markets at the entry into service of its projects.

Derived from text

Reliability; Operating Costs; Economics; Market Research

20000020793 Pratt and Whitney Aircraft of Canada Ltd., Longueuil, Quebec Canada

The PW100 Engine: 20 Years of Gas Turbine Technology Evolution

Hosking, E., Pratt and Whitney Aircraft of Canada Ltd., Canada; Kenny, D. P., Pratt and Whitney Aircraft of Canada Ltd., Canada; McCormick, R. I., Pratt and Whitney Aircraft of Canada Ltd., Canada; Moustapha, S. H., Pratt and Whitney Aircraft of Canada Ltd., Canada; Sampath, P., Pratt and Whitney Aircraft of Canada Ltd., Canada; Smailys, A. A., Pratt and Whitney Aircraft of Canada Ltd., Canada; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 4-1 - 4-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The PW100 three-spool turboprop engine family has been designed for the commuter, utility and executive aircraft markets. The first PW 100 engine, with a thermal power rating of 1780 Kw, entered service in the mid-1980s. Growth through increased pressure ratio and turbine inlet temperature as well as application of new technology has allowed the power of the engine to reach 4980 Kw for the latest PW150. This paper will highlight examples of this technical evolution covering the cold and hot end, gearbox, installation and control systems and the application of the latest three-dimensional aerodynamic and stress analysis to the design of the different components.

Derived from text

Gas Turbines; Turboprop Engines; Stress Analysis

20000020794 Daimler-Benz Aerospace A.G., Munich, Germany

Process Optimization in Advanced Compressor Design

Schulze, Gisbert, Motoren- und Turbinen-Union G.m.b.H., Germany; Geidel, Helmut A., Motoren- und Turbinen-Union G.m.b.H., Germany; Pirker, Klaus, Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 6-1 - 6-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

After an overview of MTU's current compressor projects, this paper focuses towards the fundamentals of the team oriented integrated product design process(IPD) and a new approach to its goals, the advanced multi-disciplinary design process. The new idea behind this process is the focus on the integration of the most important design skills in one person. Most of the compressor design work is performed by the same person with the support of a team of specialists of the different disciplines rather than carrying out the different tasks by different members of the team. The goal of this process is a further reduction in development lead time and cost and a better focus on project requirements rather than on certain discipline requirements.

Author

Compressors; Costs; Design; Optimization; Design to Cost; Design Analysis

20000020795 Fiat Aviazione S.p.A., Direzione Tecnica, Turin, Italy

Actuation System for Variable Exhaust Nozzle and Inlet Guide Vanes on an Advanced Gas Turbine Engine

Bardone, G., Fiat Aviazione S.p.A., Italy; Marchetti, S., Fiat Aviazione S.p.A., Italy; Trovati, A., Fiat Aviazione S.p.A., Italy; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 7-1 - 7-17; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Aircraft engines with afterburner need to have variable exhaust nozzle and inlet guide vanes in order to control the air flow. Different types of actuation systems provide the force to move such variable geometry devices. The paper describes the architecture of a hydraulic actuation system installed on a military engine of the last generation, paying particular attention to the technical solutions chosen to keep at minimum mass and heat re.jection and to the dynamic mathematical model used during the

development to predict the nozzle area behaviour, inlet guide vanes position, hydraulic oil flows and pressures as functions of external loads, engine rating and commanded positions.
Author
Actuators; Exhaust Nozzles; Intake Systems; Guide Vanes; Gas Turbine Engines; Afterburning

20000020796 Turbomeca S.A. - Brevets Szydlowski, Bordes, France
The Reliability of Aeronautical Bearings and Their Behavior in Fatigue ***La Fiabilite des Roulements Aeronautiques et le Comportement en Fatigue***
Cheftel, Brigitte, Turbomeca S.A. - Brevets Szydlowski, France; Paty, Gerard, Turbomeca S.A. - Brevets Szydlowski, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 8-1 - 8-6; In French; See also 20000020789 Contract(s)/Grant(s): BRE2-CT92-0209; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Gas turbine bearings are mechanical components which influence engine performance through this reliability. They link rotating parts to stationary ones. A bearing failure may have serious consequences such as engine out of order or aeroship maneuverability losses. Engine improvements through SFC and weight/power ratio lead to increase rotational speeds and other parameters such as applied loads and bulk temperature. As other engine manufacturers, TURBOMECA use to design bearings such to prevent typical failures observed on field. The fatigue defect is the most important to be addressed. In this context, it has been raised that an endurance limit under which no fatigue is developed exists. A research programme named ”ELABOMM” involving bearings and turbine engines Manufacturers and University and funded by the CEC was conducted during four years in order to identify the influencing parameters and the threshold of this endurance limit in dependence of their value. It resulted a model and a databank available at the en ’gine manufacturer offices which can be used to design bearings with confidence relatively to the expected fatigue behaviour.
Author
Reliability; Gas Turbines; Turbine Engines; Bearings; Failure; Fatigue (Materials)

20000020797 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA
Computer Modeling of Heat Generation in Vapor Lubricated Bearings for Gas Turbines
Forster, Nelson H., Air Force Research Lab., USA; Givan, Garry D., Air Force Research Lab., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 9-1 - 9-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Analytical and experimental data are presented for a 30 mm bore ball bearing operating at 31,000 rpm (0.93 MDN where MDN=l0(exp -6) x shaft diameter x shaft rpm), applied thrust load of 445 N (1.0 GPa maximum Hertzian contact stress), and a steady-state bulk outer race temperature of 425 C (135 C above the initial static temperature of 290 C). The bearing was lubricated with a tertiary-butyl phenyl phosphate (TBPP) delivered from the vapor phase at 325 C. The steady-state bearing torque, at the conditions described above, was 0.07 N-m, resulting in a bearing power loss of 227 W. The major advantage of vapor lubrication in gas turbines is the potential to eliminate the conventional liquid lubrication system, resulting in considerable weight and cost savings benefits. The major disadvantage of vapor lubrication, is the inability to remove the bearing heat generation due to loss of the recirculating liquid lubricant. Although heat transfer poses potential problems, the higher temperature capability of the TBPP vapor lubricant, 600 C compared to 200 C for a recirculating polyester liquid lubricant, may enable the vapor lubricant to withstand this higher heat generation. This paper takes a first look at examining heat generation in vapor lubricated bearings. to accomplish this, friction measurements were made in a single bearing contact under controlled conditions of rolling and sliding. Tile lubricant was delivered as vapor to the bearing contact. Friction measurements were made at ball temperatures of 300 C and 400 C; stress loads of 0.75 GPa, 1.00 GPa, 1.25 GPa, and 1.50 GPa; and rolling speeds of 10 m/s and 15 m/s. Using the friction measurement as input data, analysis of the bearing was performed at the experimental test conditions using the bearing computer program ADORE. After validating the computer model to match the experimental bearing heat generation, parametric computer runs were made for the bearing geometry operating at conditions of 1.0 MDN to 2.0 MDN, and applied contact loads of 1.0 GPa and 2.0 GPa. Under the most severe case, 2.0 MDN and 2.0 GPa of contact stress, the 30 mm bore test bearing is expected to generate 3742 watts of heat. Additional analysis is required to convert this heat input to the expected operational bearing temperature, but the results suggest that improved heat transfer will be required to meet the conditions at 2.0 MDN and 2.0 GPa of Hertzian contact stress.
Author
Computerized Simulation; Vapor Phases; Lubrication Systems; Lubricants; Heat Generation; Ball Bearings

20000020798 NASA Lewis Research Center, Cleveland, OH USA

Advanced Seal Technology Role in Meeting Next Generation Turbine Engine Goals

Steinetz, Bruce M., NASA Lewis Research Center, USA; Hendricks, Robert C., NASA Lewis Research Center, USA; Munson, John, Allison Engine Co., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 11-1 - 11-13; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Cycle studies have shown the benefits of increasing engine pressure ratios and cycle temperatures to decrease engine weight and improve performance in next generation turbine engines. Advanced seals have been identified as critical in meeting engine goals for specific fuel consumption, thrust-to-weight, emissions, durability and operating costs. NASA and the industry are identifying and developing engine and sealing technologies that will result in dramatic improvements and address the goals for engines entering service in the 2005-2007 time frame. This paper provides an overview of advanced seal technology requirements and highlights the results of a preliminary design effort to implement advanced seals into a regional aircraft turbine engine. This study examines in great detail the benefits of applying advanced seals in the high pressure turbine region of the engine. Low leakage film-riding seals can cut in half the estimated 4% cycle air currently used to purge the high pressure turbine cavities. These savings can be applied in one of several ways. Holding rotor inlet temperature (RIT) constant the engine specific fuel consumption can be reduced 0.9%, or thrust could be increased 2.5%, or mission fuel burn could be reduced 1.3%. Alternatively, RIT could be lowered 20 ’F resulting in a 50% increase in turbine blade life reducing overall regional aircraft maintenance and fuel bum direct operating costs by nearly 1%. Thermal, structural, secondary-air systems, safety (seal failure and effect), and emissions analyses have shown the proposed design is feasible.

Author

Sealing; Aircraft Engines; Turbine Engines; Pressure Ratio; Gas Turbine Engines

20000020799 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany

Fuel/Oil System Thermal Management in Aircraft Turbine Engines

Streifinger, Helmut, Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 12-1 - 12-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The fuel consumed by an aircraft turbine engine is the preferred heat sink for its lubrication, hydraulic, and integrated drive generator oil systems. Reasons for this are, that a fuel/oil heat exchanger is more compact, if compared with an air/oil cooler, and causes no drag increase and no engine performance loss from air bleed or loss of momentum of the air. Furthermore, the energy exchanged in the fuel/oil cooler is conserved in the thermodynamic cycle. ne capacity of the fuel as a heat sink is temperature limited, however, and the fuel pumps contribute to the fuel heating as well. Integration of the fuel and oil systems to a thermal management system is required, which performs its functions without exceeding fuel or oil temperature limits within the aircraft flight envelope. to make this possible, reduction of the oil system heat rejection, as well as the installation of air/oil heat exchangers, has to be considered early in the engine development programme (Ref. 1). A continuous analysis of the heat loads from fuel and oil systems is required, until sufficient test evidence proves that the design meets the requirements.

Derived from text

Management Systems; Fuel Oils; Thermodynamic Cycles; Turbine Engines; Aircraft Engines; Systems Management

20000020800 Rolls-Royce Ltd., Military Aero Engines, Bristol, UK

Fault Tolerant Design Methodology in Software for Safety Related Systems

Cockram, Trevor, Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 13-1 - 13-6; In English; See also 20000020789

Contract(s)/Grant(s): DTI Project IED4/1/9004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

System failures caused by software are not caused by wear out; they are due to errors in the design or specification of the software. Most activities during the software development process have the potential to cause errors in the final software code. An important mechanism in this type of systematic error is human error, both as individuals and within groups. Adherence to procedures or standards implies a kind of fault tolerant design. However, in order to judge whether practices are effective at achieving the required integrity of the product, a measurement based approach to software design is required. The methodology described has been developed to provide project managers with a means to assess the integrity of the software product at any stage prior to delivery. The product integrity is described in terms of the probability distribution for the numbers of errors that exist in any product or set of products. The approach is equally applicable to determine the effectiveness of the quality assurance processes and of any error correction mechanism including software maintenance. The methodology is supported by a tool that uses graphical probability models to describe each atomic development or review process, defining the dependencies between the

process attributes. Bayesian statistics are then used to calculate the integrity prediction using a priori experience together with evidence.
Author
Systematic Errors; System Failures; Quality Control; Procedures; Fault Tolerance; Error Analysis

20000020801 Technical Univ. of Munich, Lehrstuhl fuer Flugantriebe, Muchen, Germany
Monitoring and Control of Helicopter Engines at Abnormal Operating Conditions
Erhard, W., Technical Univ. of Munich, Germany; Gabler, R., Technical Univ. of Munich, Germany; Preiss, A., Technical Univ. of Munich, Germany; Rick, H., Technical Univ. of Munich, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 14-1 - 14-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A digital non-flight standard control system for the helicopter engine ALLISON 250-C20B has been developed. It is used as a development slave system at the institute's test bed for various research projects. The topics to be presented in this paper cover control and monitoring aspects for these types of engines in the presence of abnormal operating conditions. Investigated are compressor rotating stall and surge due to engine failure, control system failure, inlet distortion, as well as water ingestion problems. to get control over the operating line of the engine and to avoid, respectively to abort a surge condition an appropriate bleed valve can be used. Therefore the original valve is replaced by a newly developed simple and cost effective one which is integrated into the electronic control system and can be controlled by software. The software itself is developed with means of an object oriented tool and runs on a rapid prototyping real-time computer. to detect stall and surge onset as early as possible different methods of signal analysis are applied and investigated. The wavelet method as a relatively new one proved to be very interesting for such applications. But it emerged that in many cases, particularly at slam accelerations, it was not possible to avoid surge entirely with the developed system, because of insufficient actuator dynamics. Therefore a special control mode was developed to abort surge immediately and recover to normal operation.
Author
Helicopter Engines; Electronic Control; Wavelet Analysis; System Failures; Real Time Operation; Engine Failure; Abnormalities

20000020802 Purdue Univ., School of Mechanical Engineering, West Lafayette, IN USA
Simultaneous Active Source Control of Blade Row Interaction Generated Discrete Tones
Sawyer, Scott, Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 15-1 - 15-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Unsteady blade row interactions in turbomachines generate discrete-frequency tones at blade pass frequency and its harmonics. Specific circumferential acoustic modes are generated. However, only certain of these modes propagate upstream and downstream to the far field, with these the discrete frequency noise received by an observer. This paper is directed at experimentally demonstrating the viability of active noise control utilizing active airfoils to generate propagating spatial modes that interact with and simultaneously cancel the upstream and downstream propagating acoustic modes. This is accomplished by means of fundamental experiments performed in the Purdue Annular Cascade Research Facility configured with 16 rotor blades and 18 stator vanes. At blade pass frequency, only the k(sub 0) = -2 spatial mode propagates. Significant simultaneous noise reductions are achieved for these upstream and downstream propagating spatial modes over a wide range of operating conditions.
Author
Active Control; Airfoils; Noise Reduction; Turbomachinery; Rotor Blades (Turbomachinery)

20000020803 Naval Air Warfare Center, Propulsion Fuel Systems, Controls and Diagnostics, Patuxent River, MD USA
Improved Gas Turbine Response Using LQR Control
Richman, Mike, Naval Air Warfare Center, USA; Gordon, Vernon, Naval Air Warfare Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 16-1 - 16-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper develops a design methodology for a full state feedback controller using linear quadratic regulator (LQR) multivariable control techniques. The result is a controller that will perform with the quickest settle time, containing optimal stability margin while minimizing the feedback gains to realistic real world values. A correlation will be established between the weighting parameters used in a typical LQR design and their effect on steady state settle time and maximum feedback gain. The entire investigation uses MATLAB with Simulink, including an assortment of control system toolboxes, to design, trend, and evaluate the System with and without the full state feedback controller. A Simulink block diagram was used to design and test a full-state feedback controller. Settle time, maximum feedback gain, and steadystate values were plotted as a function of LQR

design parameters Q and R. These parameters weight either the state or control energy for optimization. Choosing a Q identity matrix of 10 and R identity matrix of 0.1 the system was evaluated with both a step input and a sine wave input. The controlled system reduced the steady state settle time by .5 seconds over the open loop step response.
Author
Gas Turbines; Stability; Multivariable Control; Feedback; Design Analysis; Control Systems Design

20000020804 Virginia Polytechnic Inst. and State Univ., Mechanical Engineering Dept., Blacksburg, VA USA
Unsteady, Finite-Rate Model for Application in the Design of Complete Gas-Turbine Combustor Configurations
Rodriguez, Carlos G., Virginia Polytechnic Inst. and State Univ., USA; OBrien, Walter F., Virginia Polytechnic Inst. and State Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 17-1 - 17-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Design methods for gas-turbine engine combustors require mathematical models that satisfy two simultaneous and often conflicting requirements: to provide an accurate description of the highly complex geometry and physics involved, and be sufficiently inexpensive in computational requirements as to allow its incorporation in a design cycle involving the evaluation of a great number of operating conditions. For these reasons a one-dimensional, finite-rate, unsteady combustor model has been developed that incorporates most elements found in modem gas-turbine burners, and yet is simple enough to be implemented in desktop computers. The model includes the division of the flowpath into annular and primary streams, finite-rate effects within the primary flow, and interaction between hot and cold gases though dilution holes. Examples show predictions of flow distribution within complete burner configurations, blowout predictions, and the effects of perturbations in boundary and operating conditions.
Author
Unsteady State; Combustion Chambers; Gas Turbine Engines; Mathematical Models

20000020805 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. for Propulsion Technology, Cologne, Germany
Design Principles for the Quench Zone of Rich-Quench-Lean Combustors
Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Migueis, C. E., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Voigt, P., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 18-1 - 18-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Isothermal experiments on the mixing of jet rows in crossflow with particular attention to the quench zone mixing of RQL combustor have been carried out. Comparing mixing with combusting and isothermal mixing, it could be demonstrated, that with the combination of jet air concentration measurements and numerical calculations of the flow, medium pressure combustion tests with 3-D probe measurements can be bypassed for the jet row optimization. The study with homogenuous crossflow for RQL combustors without cooling air in the primary zone showed optimum mixing with two staggered rows with close axial spacing. The light sheet technique could be demonstrated to give good quantitative results with higher spatial resolution than any other competing technique if applied with the appropriate care. Its application clearly revealed the influence of swirling, recirculating primary zone flow on the jet mixing.
Author
Design Analysis; Combustion Chambers; Fluid Jets; Jet Mixing Flow; Swirling

20000020806 Fiat Aviazione S.p.A., Direzione Tecnica, Turin, Italy
Afterburner Design and Development
Trovati, A., Fiat Aviazione S.p.A., Italy; Turrini, F., Fiat Aviazione S.p.A., Italy; Vinci, C., Fiat Aviazione S.p.A., Italy; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 19-1 - 19-24; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper deals with the design and the development of the afterburner system for an advanced fighter aircraft. The design background of the system and its major components is given, in front of design requirements. The design process is described, Outlining most important design tools, with particular attention to CFD and aerothermal modelling. The principal experimental evidences are also presented. showing the most significant achievements of system development and giving a survey of major problems and relevant solutions during the system development and optimisation process.
Author
Afterburning; Design Analysis; Manufacturing

20000020807 Motoren- und Turbinen-Union G.m.b.H., Engine System Simulation TPSZ, Munich, Germany

A Mixed Flow Turbofan Afterburner Simulation for the Definition of Reheat Fuel Control Laws

Kurzke, Joachim, Motoren- und Turbinen-Union G.m.b.H., Germany; Riegler, Claus, Deutsches Zentrum fuer Luft- und Raumfahrt e.V., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 20-1 - 20-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The afterburner fuel flow control for mixed flow turbofan engines is a complex task. At a given nozzle area, burning too much afterburner fuel can throttle the fan until it surges. On the contrary - when not enough heat is released - the fan pressure ratio will decrease and the gas velocity in the jet pipe will rise with the dan;er of blowing out the flame. Ideally, the operating point of the fan in its map should not be affected by the afterburner operation. Two different methods are in use to achieve this at least approximately. In some engines the afterburner fuel flow is controlled 'closed loop' so that a prescribed fan pressure ratio is achieved. The problem with this approach is that in case of an unexpected afterburner ignition delay the nozzle will close with the aim to keep the fan pressure ratio at the target level. When the afterburner fuel ignites in such a situation unexpectedly the nozzle probably cannot open quickly enough and therefore the pressure in the afterburner will rise sharply. This can result in a fan surge.

Derived from text

Turbofans; Afterburning; Simulation; Control Theory; Fuel Control; Multiphase Flow

20000020808 NASA Lewis Research Center, Cleveland, OH USA

Numerical Simulation of Multi-Stage Turbomachinery Flows

Adamczyk, John J., NASA Lewis Research Center, USA; Hathaway, Michael D., NASA Lewis Research Center, USA; Shabbir, Aamir, NASA Lewis Research Center, USA; Wellborn, Steven R., NASA Lewis Research Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 21-1 - 21-25; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A comprehensive assessment is made of the predictive capability of the average passage flow model as applied to multi-stage axial flow compressors. The average passage flow model describes the time average flow field within a typical passage of a blade row embedded in a multi-stage configuration. In this work data taken within a four and one-half stage large low speed compressor will be used to assess the weakness and strengths of the predictive capabilities of the average passage flow model. The low speed compressor blading is of modern design and employs stators with 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. Based on the measured wake profiles it will be argued that blade boundary layer transition is playing an important role in setting compressor performance. A model which mimics the effects of blade boundary layer transition within the frame work of the average passage model will be presented. Simulations which incorporated this model showed a dramatic improvement in agreement with data.

Author

Numerical Analysis; Computerized Simulation; Embedding; Flow Distribution; Prediction Analysis Techniques; Turbomachinery

20000020809 Turbomeca S.A. - Brevets Szydlowski, Aerothermodynamic Dept., Bordes, France

Performance Analysis of Centrifugal Compressor Stage, by Means of Numerical and Experimental Investigation of Rotor-Stator Interactions

Domercq, O., Turbomeca S.A. - Brevets Szydlowski, France; Thomas, R., Turbomeca S.A. - Brevets Szydlowski, France; Carrere, A., Ecole Nationale Superieure de l'Aeronautique et de l'Espace, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 22-1 - 22-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper deals with numerical and experimental investigations of rotor-stator interactions between a backswept centrifugal impeller and its associated vaned diffuser. Experimental data were obtained by laser two focus velocimetry and fast response Kulite transducers. Computations were carried out thanks to a three-dimensional Navier-Stokes solver, customized by the authors, for the current purpose. Time-resolved simulations of the full stage with passages number reduction but respect to real geometry of components are then presented. Comparisons with experimental data lead to a code validation phase and critic investigations of rotor-stator interaction phenomena. Evidence of the existence of a strong interaction between the rotor and the stator flow fields are pointed out. In particular, an intense upstream influence of the vaned diffuser was observed. Finally, steady stage calculations, coupling the components by a mean interfacial treatment, are examined. The reasonable computational cost of this method now allows such numerical simulations of centrifugal stages to be part of design cycles. The numerical part of the study was performed at Turbomeca, using the local software and hardware facilities, whereas the experimental campaign took place in the Propulsion

Laboratory of SUPAERO, part of the LAMEP (Laboratoire Mixte en Energetique et Propulsion), which recently designed a test rig devoted to compressors.
Author
Centrifugal Compressors; Centrifugal Force; Computer Programs; Numerical Analysis; Experimentation; Reliability Analysis; Rotor Stator Interactions

20000020810 Von Karman Inst. for Fluid Dynamics, Turbomachinery Dept., Rhode-Saint-Genese, Belgium
Three-Dimensional Inverse Design Method for Turbine and Compressor Blades
Demeulenaere, A., Von Karman Inst. for Fluid Dynamics, Belgium; VandenBraembussche, R. A., Von Karman Inst. for Fluid Dynamics, Belgium; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 23-1 - 23-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

An iterative procedure for turbomachinery blade design, in which the three-dimensional blade shape is modified by means of a physical algorithm and the transpiration model, is presented. The transpiration flux is defined from the velocity normal to the wall, computed by means of a modified Euler solver when the target pressure distribution is imposed along the blade surfaces. This method is very efficient as it needs only a limited amount of computer time to obtain the required geometry. After a short description of the method this paper focuses on some special features that have been introduced to enhance convergence and to facilitate compliance with required performances and mechanical constraints. Each of these techniques is illustrated with an example.
Author
Computer Aided Design; Turbine Blades; Compressor Blades; Iterative Solution; Reverse Engineering; Algorithms

20000020811 NASA Lewis Research Center, Cleveland, OH USA
A One Dimensional, Time Dependent Inlet/Engine Numerical Simulation for Aircraft Propulsion Systems
Garrard, Doug, Sverdrup Technology, Inc., USA; Davis, Milt, Jr., Sverdrup Technology, Inc., USA; Cole, Gary, NASA Lewis Research Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 25-1 - 25-10; In English; See also 20000020789
Contract(s)/Grant(s): NASA Order C-71064-E; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The NASA Lewis Research Center (LeRC) and the Arnold Engineering Development Center (AEDC) have developed a closely coupled computer simulation system that provides a one dimensional, high frequency inlet/engine numerical simulation for aircraft propulsion systems. The simulation system, operating under the LeRC-developed Application Portable Parallel Library (APPL), closely coupled a supersonic inlet with a gas turbine engine. The supersonic inlet was modeled using the Large Perturbation Inlet (LAPIN) computer code, and the gas turbine engine was modeled using the Aerodynamic Turbine Engine Code (ATEC). Both LAPIN and ATEC provide a one dimensional, compressible, time dependent flow solution by solving the one dimensional Euler equations for the conservation of mass, momentum, and energy. Source terms are used to model features such as bleed flows, turbomachinery component characteristics, and inlet subsonic spillage while unstarted. High frequency events, such as compressor surge and inlet unstart, can be simulated with a high degree of fidelity. The simulation system was exercised using a supersonic inlet with sixty percent of the supersonic area contraction occurring internally, and a GE J85-13 turbojet engine.
Author
Engine Design; Computerized Simulation; Supersonic Inlets; Propulsion System Configurations; Mathematical Models; Applications Programs (Computers)

20000020813 Rolls-Royce Ltd., Derby, UK
The Introduction of Reinforced TMC Materials Into Rotating Machinery: The Safe Approach
Doorbar, P. J., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 27-1 - 27-7; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Titanium metal matrix composites (TMCs) will play a significant role in the future of gas turbine aero-engine development, in particular when used for rotating disc/blade assemblies in axial flow compressors. This paper outlines the potential applications for TMCs and covers some of the main issues involved in the safe introduction of this relatively new class of composite material into critical engine components. The key microstructural features which affect the mechanical performance of finished components are explained, (e.g. fibre damage, fibre placement, interfacial bonding and embrittlement etc.) and illustrations are given of how they can be controlled in the manufacturing process for a complex component.
Author
Metal Matrix Composites; Turbocompressors; Engine Parts

20000020814 Technische Univ., Dept. of Gas Turbines and Flight Propulsion, Darmstadt, Germany

Design of an Active Stall Avoidance System for a Subsonic Axial Compressor

Schulze, R., Technische Univ., Germany; Hennecke, D. K., Technische Univ., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 28-1 - 28-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A single-stage subsonic compressor was examined as a basis for an active stall avoidance system. The process of stall inception was investigated as well as the modes of unstable operation. On the basis of the experimental results, a sensor/actuator scheme was chosen for the control system. A simple and robust stall detection system has been developed and implemented on a real-time computer. The control system's capability of stabilizing the compressor was shown in first experiments. The experiments were analyzed in detail.

CASI

Turbocompressors; Stabilization; Control Systems Design; Rotating Stalls

20000020815 NASA Lewis Research Center, Cleveland, OH USA

Rotating Pip Detection and Stall Warning in High-Speed Compressors Using Structure Function

Bright, Michelle M., NASA Lewis Research Center, USA; Qammar, Helen, Akron Univ., USA; Vhora, Hanif, Akron Univ., USA; Schaffer, Michael, Akron Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 29-1 - 29-7; In English; See also 20000020789

Contract(s)/Grant(s): NSF CTS-95-02327; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A statistic for both rotating pip and incipient stall detection, called Structure Function is introduced for use in high speed research compressor environments. Experimental studies on stall inception processes have long observed two types of pre-stall compressor activity. Presently there exist methods for indicating modal stall precursive events in the compressor. This is a first application of a new method to detect rotating pip activity prior to stall in research compressors. The algorithm requires a very short sample of data to distinguish pip activity prior to stall, and thus may be used in a real time application. Additionally, this Structure Function algorithm is also used as a single sensor stall warning method under a variety of operating conditions, including clean inlet conditions, radially and circumferentially distorted inlet conditions, and in examples of steady air injection along the casing, and controlled air injection conditions. Structure Function provides a potential advantage over linear spectral techniques and wavelet algorithms for stall detection due to the simplicity of the algorithm and because it does not rely on a priori knowledge of frequency content.

Author

Rotating Stalls; Turbocompressors; Fault Detection; Prediction Analysis Techniques

20000020816 Von Karman Inst. for Fluid Dynamics, Turbomachinery Dept., Rhode-Saint-Genese, Belgium

Turbomachinery Blade Design Using a Navier-Stokes Solver and Artificial Neural Network

Pierret, S., Von Karman Inst. for Fluid Dynamics, Belgium; VandenBraembussche, R. A., Von Karman Inst. for Fluid Dynamics, Belgium; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 30-1 - 30-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper describes a knowledge-based method for the automated design of more efficient turbine blades. Two-dimensional blade sections, defined by Bezier curves as a function of 15 parameters, are first optimized by means of Simulated Annealing (SA) and an Artificial Neural Network (ANN). The later one is an approximate model (response surface) of the 2D Navier-Stokes solutions of previous designs stored in a database. Depending on the performance predicted by a Navier-Stokes analysis the procedure will be stopped or the design cycle will be repeated after the newly designed blade has been added to the database. This extended database allows a more reliable optimization of the blade at next iteration. This procedure results in a considerable speed-up of the design process by reducing both the interventions of the operator and the computational effort. It is also shown how such a method allows the design of more efficient blades while satisfying both the aerodynamic and mechanical constraints. In this paper, emphasis is put on the formulation of a new objective function and its validation by means of three different blade designs.

Author

Turbine Blades; Engine Design; Applications Programs (Computers); Neural Nets; Optimization; Simulated Annealing

20000020817 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Turbine Aero and Cooling Dept., Moissy-Cramayel, France

Advanced CFD Tools for Multi-Stage Turbine Analysis

Liamis, N., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Duboue, J.-M., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 31-1 - 31-12; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The purpose of this contribution is to report on the aerodynamical performance calculations carried out around high and low pressure turbines. Two different turbine configurations are considered : a single stage high pressure turbine including rotor blade tip clearance effects and a four stage low pressure turbine. A multi-stage approach based on the ONERA-Snecma 3D Navier-Stokes code CANARI is used to investigate the turbine flow behavior. The computational results are compared with experimental data.

Author

Computational Fluid Dynamics; Axial Flow Turbines; Applications Programs (Computers); Performance Prediction

20000020818 Rolls-Royce Ltd., Turbine Engine Systems, Bristol, UK

Advanced Computational Fluid Dynamics in the Design of Military Turbines

Gwilliam, N. J., Rolls-Royce Ltd., UK; Kingston, T. R., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 32-1 - 32-11; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Today's design of turbine blade challenges the designer to meet the demanding requirements of overall increase in engine performance - more power for the same weight, greater engine efficiency and fuel economy. This has resulted in designs to cater for higher blade loading and faster rotational speeds. to achieve this, highlift shroudless designs are being adopted. One of the greatest challenges to the aerodynamic designer is the design of such blading so that the additional losses incurred, shock losses, greater secondary flows and susceptability to tip clearance are minimised. to do so, it is essential to be able to carry out an accurate three-dimensional analysis of the flow within the stage. This is achieved using computational fluid dynamics. This paper aims to describe and evaluate some of the tools available at Rolls Royce plc. for the numerical simulation of turbine flows. It was generated as part of a study to analyse a 'datum' and 'highlift' HP (high pressure) turbine, so as to establish both where losses occurred, and which CFD (Computational Fluid Dynamics) codes could best analyse the blading.

Author

Computational Fluid Dynamics; Turbine Blades; Engine Design; Computerized Simulation; Applications Programs (Computers)

20000020819 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany

Automatic Three-Dimensional Cyclic Crack Propagation Predictions With Finite Elements at the Design Stage of an Aircraft Engine

Dhondt, G., Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 33-1 - 33-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

At MTU a method was devised to perform linear elastic three dimensional (3-D) mixed-mode cyclic crack propagation calculations with the finite element method (FE) in a fully automatic way. The core of the method consists of an algorithm to modify an existing mesh consisting of 20-node 3-D brick elements to accommodate an arbitrarily shaped crack. Starting from the initial crack, the mixed-mode stress intensity factor (K) distribution is determined along the crack front and a crack increment is calculated leading to a new crack shape. This procedure is repeated about every 100 cycles until the desired crack length has been reached. Use of the superelement technique allows to perform more than 100 iterations within 24 hours for a realistic engine component.

Author

Aircraft Engines; Crack Propagation; Finite Element Method; Engine Design; Engine Parts

20000020820 Imperial Coll. of Science Technology and Medicine, London, UK

Forced Response Predictions for a HP Turbine Rotor Blade

Vahdati, M., Imperial Coll. of Science Technology and Medicine, UK; Green, J., Rolls-Royce Ltd., UK; Marshall, J. G., Rolls-Royce Ltd., UK; Imregun, M., Imperial Coll. of Science Technology and Medicine, UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 34-1 - 34-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents two different strategies for the prediction of blade vibration levels under forced response. The first strategy is an uncoupled approach where the wake forces on the blade are obtained via a linearized aerodynamic model and fed into a reduced structural model. The aeroelastic solution is then performed either in the frequency or the time domain. The second approach is an integrated non-linear analysis that considers a multi-stage multi-passage and that includes the flexibility of the rotor blades. The analysis is then conducted in the time domain using non-linear unsteady aerodynamics. A case study was conducted for a HP turbine stage with 36 stator and 92 rotor blades. The response levels to a 36 engine order excitation were predicted using both the linearized uncoupled and nonlinear integrated approaches and the findings were compared with available experimental data. Good overall agreement was reached for most of the cases studied.
Author
Turbine Blades; Forced Vibration; Aerodynamic Forces; Rotor Blades (Turbomachinery)

20000020821 Pennsylvania State Univ., Dept. of Aerospace Engineering, University Park, PA USA
Aero-Thermo-Structural Design Optimization of Internally Cooled Turbine Blades
Dulikravich, G. S., Pennsylvania State Univ., USA; Martin, T. J., Pennsylvania State Univ., USA; Dennis, B. H., Pennsylvania State Univ., USA; Lee, E., Pennsylvania State Univ., USA; Han, Z.-X., Pennsylvania State Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 35-1 - 35-12; In English; See also 20000020789
Contract(s)/Grant(s): NAG3-1995; NSF DMI-95-22854; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A set of robust and computationally affordable inverse shape design and automatic constrained optimization tools have been developed for the improved performance of internally cooled gas turbine blades. The design methods are applicable to the aerodynamics, heat transfer, and thermoelasticity aspects of the turbine blade. Maximum use of the existing proven disciplinary analysis codes is possible with this design approach. Preliminary computational results demonstrate possibilities to design blades with minimized total pressure loss and maximized aerodynamic loading. At the same time, these blades are capable of sustaining significantly higher inlet hot gas temperatures while requiring remarkably lower coolant mass flow rates. These results suggest that it is possible to design internally cooled turbine blades that will cost less to manufacture, will have longer life span, and will perform as good, if not better than, film cooled turbine blades.
Author
Structural Design; Turbine Blades; Design Analysis; Gas Turbines; Computational Fluid Dynamics; Multidisciplinary Design Optimization

20000020822 Rolls-Royce Ltd., Turbine Research, Bristol, UK
The Benefits of a Rotating Rig for Research Into Advanced Turbine Cooling Systems
Davenport, R., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 37-1 - 37-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Internal cooling of turbine blades is essential for efficient turbine engine performance and dictates the life of the component. Engine specific thrust and efficiency benefit from blade cooling although the use of cooling air imposes cycle penalties and can reduce aerodynamic efficiency. Cooling research aims to develop and validate design methods to give maximum cooling effectiveness for minimum cooling flow. The design methods need to be reliable reducing the risks in future projects thus helping to avoid in-service short falls and high maintenance costs. Current design methods have been almost exclusively derived from experiments performed using simplified cooling geometries without the influence of rotation, which is perfectly feasible for nozzle guide vane designs but sadly lacking for rotor designs. However, it is important to pursue both static and rotating experiments to establish the effects of rotation and to determine design rules that allow corrections to static experimental data. All the experimental data can be used to validate Computational Fluid Dynamics (CFD) modelling which has difficulty in predicting heat transfer levels in highly turbulent 3D flows.
Author
Computational Fluid Dynamics; Cooling Systems; Engine Design; Design Analysis

20000020823 NASA Lewis Research Center, Cleveland, OH USA
Simulation of Crack Propagation in Engine Rotating Components Under Variable Amplitude Loading
Bonacuse, P. J., Army Research Lab., USA; Ghosn, L. J., Case Western Reserve Univ., USA; Telesman, J., NASA Lewis Research Center, USA; Calomino, A. M., NASA Lewis Research Center, USA; Kantzos, P., Ohio Aerospace Inst., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 38-1 - 38-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The crack propagation life of tested specimens has been repeatedly shown to strongly depend on the loading history. Overloads and extended stress holds at temperature can either retard or accelerate the crack growth rate. Therefore, to accurately

predict the crack propagation life of an actual component, it is essential to approximate the true loading history. In military rotorcraft engine applications, the loading profile (stress amplitudes, temperature, and number of excursions) can vary significantly depending on the type of mission flown. To accurately assess the durability of a fleet of engines, the crack propagation life distribution of a specific component should account for the variability in the missions performed (proportion of missions flown and sequence). In this report, analytical and experimental studies are described that calibrate/validate the crack propagation prediction capability for a disk alloy under variable amplitude loading. A crack closure based model was adopted to analytically predict the load interaction effects. Furthermore, a methodology has been developed to realistically simulate the actual mission mix loading on a fleet of engines over their lifetime. A sequence of missions is randomly selected and the number of repeats of each mission in the sequence is determined assuming a Poisson distributed random variable with a given mean occurrence rate. Multiple realizations of random mission histories are generated in this manner and are used to produce stress, temperature, and time points for fracture mechanics calculations. The result is a cumulative distribution of crack propagation lives for a given, life limiting, component location. This information can be used to determine a safe retirement life or inspection interval for the given location.
Author
Crack Propagation; Engine Parts; Computerized Simulation; Variable Amplitude Loading

20000020824 Oxford Univ., Dept. of Engineering Science, Oxford, UK
Theory for the Use of Foreign Gas in Simulating Film Cooling
Jones, T. V., Oxford Univ., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 39-1 - 39-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In the film cooling of turbines the coolant is significantly cooler than the freestream. Consequently the coolant is at a higher density and this plays an important role in determining the flowfield. In laboratory experiments with small temperature differences this density difference is simulated by using dense foreign gas. This paper analyses the effect of molecular properties on the thermal measurements so that they may be related to the cold air situation.
Author
Film Cooling; Computerized Simulation

20000020825 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Materials Research, Cologne, Germany
The Potential of Advanced Materials on Structural Design of Future Aircraft Engines
Kumpfert, J., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Peters, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Kaysser, W. A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 42-1 - 42-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

For a gas turbine engine manufacturer the direct operating costs (DOC) of aircraft engines is primarily reduced by control of fuel costs, maintenance costs, and through weight savings. All aspects are strongly influenced by the materials technology available and can improve the component efficiency significantly. The recent development of conventional high temperature titanium alloys has demonstrated the in-service capabilities of conventional materials due to better understanding of microstructure/property relationships. Beyond these capabilities new light-weight materials as titanium aluminides and titanium matrix composites (TMCs) may improve engine performance significantly. In particular TMCs can improve compressor efficiency by enabling new compressor design not feasible with any other material used today. Increased turbine efficiency depends primarily on the gas turbine inlet temperature. to further increase the thrust-to-weight ratio and decrease the specific fuel consumption new aircraft engines will require gas turbine inlet temperatures well beyond 1600 C. Since new structural high temperature materials capable of service temperatures significantly above current high pressure turbine temperatures are not feasible in short-term other innovative technologies are required. This is in particular through the introduction of electron-beam physical vapor deposition (EB-PVD) thermal barrier coatings (TBCs). Reduced emissions and lower specific fuel consumption (SFQ) of next generation jet engines depend predominantly on new combustor design. Very low emission combustors require revolutionary materials as ceramic matrix composites (CMCs) to replace the metallic liner currently in use. The potential payoff, processing, and properties of conventional high temperature titanium alloys, titanium aluminides, TMCs, TBCs, and CMCs are highlighted regarding applications in aircraft engines.
Author
Structural Design; Aircraft Design; Aircraft Engines; Ceramic Matrix Composites

20000020826 Rolls-Royce Ltd., Performance Systems, Bristol, UK

Cycle-Match Engine Models Used in Functional Engine Design: An Overview

Horobin, Marcus S., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 44-1 - 44-22; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The wider use of iterative thermodynamic (cycle-match) engine models across the functional design process offers many technical and organizational benefits which contribute to reduced risk in engine development programmes. The use of low and high order engine models for control-system design and validation is used to illustrate some of these advantages. The principles of the iterative technique are discussed with reference to the extra capabilities required of models used for control-system design and validation. Some related issues e.g. increased model capability, complexity and user-acceptability are also discussed.
Author

Engine Design; Thermodynamic Cycles; Functional Design Specifications; Design Analysis

20000020827 Kansas Univ., Aerospace Engineering Dept., Lawrence, KS USA

Smart Flow Control in Aircraft Engine Components and Component Interactions

Farokhi, S., Kansas Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 45-1 - 45-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Adverse flow environments pose challenging design constraints in aircraft engine components and component interactions. Some examples of such flow environments are: steep pressure gradients, random and periodic unsteadiness, shock wave interactions and 3-D boundary layer separation. These adverse flow environments and interactions promote the growth of various kinds of instability waves inherent in gas turbine engines, e.g., vorticity wave, entropy wave and acoustic or pressure wave instabilities. A series of smart subsonic and supersonic flow controllers are presented with applications to the design of aircraft gas turbine engine components. They are on-demand vortex generators capable of injecting co- and counter-rotating streamwise vortices in subsonic, transonic and supersonic flow. The strength and location of the vortex is a control variable and must be optimized via a closed-loop control algorithm. The subsonic smart Vortex Generator (VG) assumes a ramp-type geometry (similar to Wheeler vortex generators) and the smart supersonic VG is a tailored cavity with a movable flap concealing the cavity. The movable flap is actuated inward to expose the cavity to transonic or supersonic flow. The depth of the cavity is controlled via a closed-loop feedback control system which ties the strength of the vortex to the ”desired” performance as measured by one or more sensors. Candidate cost functions are proposed in the optimization routine for each component in a gas turbine engine.
Author

Flow Characteristics; Aircraft Engines; Design Analysis; Aircraft Design

20000020828 Naval Air Systems Command, Propulsion and Power Engineering, Patuxent , MD USA

F/A-18 E/F Aircraft Engine (F414-GE-400) Design and Development Methodology

Burnes, Robert, Naval Air Systems Command, USA; Blottenberger, Don, Naval Air Systems Command, USA; Elliott, Michael, Naval Air Systems Command, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 46-1 - 46-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In the 1970’s the USA Navy (USN) faced a dilemma. The F-4 Phantom and A-7 Corsair aircraft were aging rapidly and new threats were arising as technology advanced. to answer the call for a new attack fighter, the USN developed and deployed the F/A-18 aircraft. In 1987, the Secretary of Defense directed the USN to study advanced versions of the F/A-18 to face threats into the twenty-first century. This study resulted in the F/A-18 E/F. The F/A-18 E/F represents the next level in the evolution of the F/A-18 Attack Fighter. From the beginning, the objective has remained stable; to define an affordable system taking full advantage of the cost benefits associated with a derivative system without compromise of mission capabilities.
Derived from text

Aircraft Engines; Engine Design

20000020846 Defence Evaluation Research Agency, Combustion and Emissions Section, Farnborough, UK

Measurement and Prediction of NO and NO2 Emissions from Aero Engines

Foster, T. J., Defence Evaluation Research Agency, UK; Wilson, C. W., Defence Evaluation Research Agency, UK; Pourkashanian, M., Leeds Univ., UK; Williams, A., Leeds Univ., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 19-1 - 19-9; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Aircraft fitted with afterburner systems for increased thrust have been observed to have NOx emissions with a higher proportion of nitrogen dioxide (N02) than non-augmented aircraft. These emissions are generally characterised by a brown plume and has implications for aircraft visibility and stealth as well as environmental considerations. This paper describes the CFD

modelling of NOx emissions from a modern afterburner system. A commercial CFD code, Fluent, was used to develop and solve a three dimensional model of a ”burn then mix” afterburner system under investigation. A post processor package has been developed and was used to calculate both NO and NO2 concentrations. Four reheat settings were investigated; minimum, 25%, 50% and maximum reheat. For all conditions investigated the bulk of NOx emission was found in the core, stemming from the vitiated combustor air flow. NOx was also formed in the bypass stream, the production zone was found to be close to the fuel sprayers and flame stabiliser at minimum reheat, but moved downstream towards the exit nozzle as reheat power was increased. The model showed that for all the conditions under investigation, over 90% of the NOx produced in the reheat system was formed via the thermal-NO route. The model has been compared with centre-line traverse data measured at the exit nozzle of the engine on a sea-level static test bed. The predicted NOx emissions agreed quantitatively with the experimental measurements to within +/- 5%

Author

Afterburning; Nitrogen Dioxide; Nitrogen Oxides; Exhaust Emission; Plumes; Gas Turbine Engines; Three Dimensional Models

20000020847 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Propulsion Technology, Cologne, Germany

Influence of Engine Performance on Emission Characteristics

Doepelheuer, A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Lecht, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 20-1 - 20-12; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper concentrates on the results of different investigations on aircraft engine emissions. In a first step semi-empirical emission correlation methods to predict the sum of nitric oxide and nitrogen dioxide (NOx), carbon monoxide (CO), hydrocarbons (HC) and soot are introduced. They all are of a ”variable” reference type meaning, that published sea level static (SLS) measurements will be used as a reference. to calculate the amount of emissions for altitude operating conditions, the actual parameters involved like the fuel flow (for the NOx correlation method), the reciprocal value of the combustor loading parameter (for the CO and HC correlation methods) and the combustor inlet temperature and pressure, the flame temperature and the equivalence ratio (for the soot correlation method) are set into relation to the respective reference ground values. The necessary internal engine parameters are received from a thermodynamic engine modelling program shortly described in this paper. Because of the fact, that the engine thermodynamic state is mainly determined by the thrust demand of the aircraft and the ambient conditions, not only engines, but also aircraft engine combinations on different flight missions had to be looked at. Therefore a flight performance module is presented, which allows - in combination with the engine modelling program and the emission calculation methods detailed simulations and investigations of flight missions on the entire route. As a result not only the effects of engine performance modes and parameters (like bypass ratio in combination with overall pressure ratio) but also the effects of ambient conditions (like wind and ambient temperature) and flight profile (like cruise altitude, step climb, take off weight and payload factor) on the fuel burned and the emissions produced by different engines and aircraft in use are investigated. Finally the results of a comparison between a subsonic and a supersonic mission and a comparison between a jet aircraft of the first generation and a modern type are given.

Author

Aircraft Engines; Exhaust Emission; Propulsion System Performance; Environment Effects; Pollution; Thermodynamics; Mathematical Models

20000020854 Defence Evaluation Research Agency, Propulsion Dept., Farnborough, UK

A Novel Technique for Predicting the Ignition Performance of an Aero Gas Turbine Combustion Chamber

Wilson, C. W., Defence Evaluation Research Agency, UK; Sheppard, C. G. W., Leeds Univ., UK; Low, H. C., Rolls-Royce Ltd., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 29-1 - 29-12; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The work reported in this report is directed towards improvements in the ignition of gas turbine combustors. Currently available design rules are incapable of predicting the improved performance obtained with different ignition systems or igniter placement. Work has been carried out to address the inadequacies, in the current ignition prediction techniques, using Computational Fluid Dynamics (CFD). A preliminary validation of the CFD ignition prediction technique was performed using ignition results from a fully annular research combustor. Qualitatively, the effect of igniter position, igniter type and combustor mass flow rate on ignition performance have been predicted, by inspection of the Karlovitz number encountered by a tracer, used to model a developing ignition kernel.

Author

Combustion Chambers; Ignition Systems; Gas Turbine Engines; Igniters; Performance Prediction

20000020929 Naval Postgraduate School, Monterey, CA USA
Analysis of the Tip Leakage Flow Field in an Axial Turbine
Anderson, C. S.; Jun. 1999; 189p; In English
Report No.(s): AD-A371278; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Comparisons of experimental laser-Doppler-velocimetry measurements using the Naval Postgraduate School cold-flow turbine test rig were made with 3D viscous computational fluid dynamics flow solutions. The turbine tested was the first stage of the Pratt and Whitney designed High Pressure Fuel Turbopump for the Space Shuttle Main Engine. The laser anemometer was modified to incorporate a field stop, which acted as a spatial filter to limit reception of undesired blade reflections. The laser measurements were made in the endwall region of the test turbine, at three axial locations, and at three radial depths. For each location, absolute flow angle, axial and tangential velocity ratios, turbulence intensities and correlation coefficients were measured. The computational effort encompassed modeling a single blade passage of both the stator and the rotor and computing flow solutions of the stage using NASA software. Exit plane and endwall flow property profiles showed good agreement when compared with experimental data.
DTIC
Axial Flow Turbines; Leakage; Flow Distribution; Data Acquisition; Three Dimensional Flow

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).

20000015406 Science Applications International Corp., Arlington, VA USA
Heliport Lighting: US Park Police Demonstration *Final Report*
Fontaine, Scott A.; McConkey, Edwin D.; Nov. 1998; 47p; In English
Contract(s)/Grant(s): DTFA01-93-C-00030
Report No.(s): AD-A371430; DOT/FAA/ND-98/4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This demonstration/evaluation of prototype heliport lighting system components was part of a larger effort to research the requirements for lighting systems to support precision approaches to heliports. Based on the success of a VFR prototype system demonstrated in conjunction with Operation Heli-STAR (DOT/FAA/AND-97/20), it was decided to continue the demonstration/evaluation at the USA (U.S.) Park Police Heliport in Washington, D.C.. The arrangement has proven to be extremely valuable, due in large part to the cooperation and assistance of the officers, pilots, and aircrew of the U.S. Park Police Aviation Section. This reports documents the initial evaluation of a laser diode localizer, a laser diode glideslope indicator, a light pipe, cold cathode line-up and landing system, and a light bar ”alignment of elements” glideslope indicator. Some insights and lessons learned regarding the use of simulation in lighting system development are also presented.
DTIC
Landing Aids; Lighting Equipment; Heliports; Illuminating

20000019575 NASA Goddard Space Flight Center, Greenbelt, MD USA
The NGST and the Zodiacal Light in the Solar System
Gorkavyi, Nick, NASA Goddard Space Flight Center, USA; Ozernoy, Leonid, George Mason Univ., USA; Mather, John, NASA Goddard Space Flight Center, USA; Taidakova, Tanya, Computational Consulting Service, USA; [1999]; 6p; In English; NGST Science and Technology Exposition, Unknown; Sponsored by Astronomical Society of the Pacific, USA
Contract(s)/Grant(s): NAG5-7065; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We develop a physical model of the zodiacal cloud incorporating the real dust sources of asteroidal, cometary, and kuiperoidal origin. Using the inferred distribution of the zodiacal dust, we compute its thermal emission and scattering at several wavelengths (1.25, 5, and 20 micron) as a function of NGST location assumed to be at 1 AU or 3 AU. Areas on the sky with a minimum of zodiacal light are determined.
Author
Solar System; Thermal Emission; Zodiacal Dust; Zodiacal Light; Mathematical Models; Light Scattering

20000019660 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
US Airports: Selected Airports' Views on Federal Requirements
Jan. 29, 1999; 34p; In English
Report No.(s): PB2000-101812; GAO/RCED-99-58R; B-281433; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

You asked us to identify (1) which federal laws, regulations, and administrative requirements potentially affect airports' development, operations, and financing and (2) which federal requirements airport officials view as having a positive or negative effect on their airports and why. To respond to your request, we developed a list of federal requirements applicable to airports. After developing this list, we surveyed officials from approximately 100 airports as to the effect of these requirements on their airports. The airports ranged in size from small airports serving privately owned aircraft to the country's largest commercial airports.
NTIS
Airports; Government/Industry Relations; Regulations

20000021001 Federal Aviation Administration, General Aviation and Vertical Flight Program Office, Washington, DC USA
FAA Helicopter/Vertiport Lighting Conference: Proceedings *Final Report*
Smith, Robert D., Federal Aviation Administration, USA; Nov. 1999; 271p; In English
Report No.(s): AD-A370873; DOT/FAA/ND-99/1; No Copyright; Avail: CASI; A03, Microfiche; A12, Hardcopy

As the vertical flight industry moves into instrument flight rules (IFR) operations at heliports, it has become apparent to both FAA and the users that there is research and development to be done on heliport lighting. With the civil tiltrotor now in production, there is also work to be done on vertiport lighting. The lighting industry has developed a variety of technologies that appear promising as candidate heliport and vertiport lighting components. Still, there are many questions still to be answered. For example: Which technologies can best provide the different visual cues needed by the pilot? What lighting configurations are most effective in various scenarios? to what criteria should some of these lights be certificated? Some of these and other questions will be answered by the marketplace. Other questions should be addressed via research and development. In looking at the heliport lighting research done by the FAA over the last decade and the resulting advisory circular guidance, it is clear that there are many more questions than answers. to answer these questions would require much more in the way of resources than what is likely to be available in the near future. With this in mind, the FAA sought the advice of the aviation community on how we could best proceed. A two-day technical conference was the mechanism used. This report documents the proceedings of this conference.
DTIC
Helicopters; Instrument Flight Rules; Conferences; Illuminating; Heliports

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.

20000017947 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
The Space-Based Visible (SBV) Program
Stokes, Grant H., Massachusetts Inst. of Tech., USA; Lincoln Laboratory Journal; 1998; Volume 11, No. 2, pp. 205-238; In English
Contract(s)/Grant(s): FE19628-95-C_0002
Report No.(s): AD-A369261; MIT-JA-7644; ECSC-TR-98-077; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The Midcourse Space Experiment satellite was launched in 1996 into an 898-km altitude, near sun-synchronous orbit. A principal sensor on board the satellite is the Space-Based Visible (SBV) sensor, a visible-band electro-optical camera designed at Lincoln Laboratory to perform the first technical and functional demonstration of space-based space surveillance. The principal task of the SBV sensor is to gather metric and photometric information on a variety of resident space objects (RSO). In 1997 after the successful technology demonstration phase of the mission, the SBV sensor was transitioned to a Contributing Sensor in the Space-Surveillance Network Since April 1998, upon completion of the transition and testing phase, the SBV sensor has responded to daily tasking requests from the 1st Command and Control Squadron, in Cheyenne Mountain, in support of routine RSO catalog maintenance.
Author
Cameras; Electro-Optics; Spaceborne Experiments; Visible Spectrum; Space Surveillance (Spaceborne); Satellite-to-Satellite Tracking

14
GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

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

20000017932 NASA Glenn Research Center, Cleveland, OH USA
Zero Gravity Research Facility User's Guide
Thompson, Dennis M., NASA Glenn Research Center, USA; December 1999; 36p; In English
Contract(s)/Grant(s): RTOP 398-95-OD
Report No.(s): NASA/TM-1999-209641; NAS 1.15:209641; E-11972; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Zero Gravity Research Facility (ZGF) is operated by the Space Experiments Division of the NASA John H. Glenn Research Center (GRC) for investigators sponsored by the Microgravity Science and Applications Division of NASA Headquarters. This unique facility has been utilized by scientists and engineers for reduced gravity experimentation since 1966. The ZGF has provided fundamental scientific information, has been used as an important test facility in the space flight hardware design, development, and test process, and has also been a valuable source of data in the flight experiment definition process. The purpose of this document is to provide information and guidance to prospective researchers regarding the design, buildup, and testing of microgravity experiments.
Author
Microgravity; Weightlessness; Drop Towers; Low Gravity Manufacturing; Research Facilities

20000020497 Brandeis Univ., Waltham, MA USA
The Rotating Room Facility of the Ashton Graybiel Spatial Orientation Laboratory
DiZio, Paul, Brandeis Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 106-112; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Strategic program goals in facility usage and development are: operation of alternating gradient synchrotron (AGS) for approximately 600 beam hours/year; operation of Loma Linda University (LLU) proton facility for approximately 400 beam hour/year; construction of booster application facility (BAF); and collaborative research at heavy ion accelerator in Chiba (HIMAC), in Japan and with other existing or potential international facilities. Memorandum of agreement (MOA) with LLU has been established to provide proton beams with energies of 40 - 250 important for trapping protons and solar proton events.
CASI
Construction; Ion Accelerators; Proton Beams; Synchrotrons; Research Facilities

20000020683 NASA Ames Research Center, Moffett Field, CA USA
Life Sciences Division Spaceflight Hardware
Yost, B., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 593; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Ames Research Center (ARC) is responsible for the development, integration, and operation of non-human life sciences payloads in support of NASA's Gravitational Biology and Ecology (GB&E) program. to help stimulate discussion and interest in the development and application of novel technologies for incorporation within non-human life sciences experiment systems, three hardware system models will be displayed with associated graphics/text explanations. First, an Animal Enclosure Model (AEM) will be shown to communicate the nature and types of constraints physiological researchers must deal with during manned space flight experiments using rodent specimens. Second, a model of the Modular Cultivation System (MCS) under development by ESA will be presented to highlight technologies that may benefit cell-based research, including advanced imaging technologies. Finally, subsystems of the Cell Culture Unit (CCU) in development by ARC will also be shown. A discussion will be provided on candidate technology requirements in the areas of specimen environmental control, biotelemetry, telescience and telerobotics, and in situ analytical techniques and imaging. In addition, an overview of the Center for Gravitational Biology Research facilities will be provided.
Author
Life Sciences; Hardware; Communication Networks; Fabrication; Payloads; Telerobotics; Spaceborne Experiments; Gravitational Physiology; Environmental Control; Unmanned Spacecraft

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.

20000017998 Georgia Inst. of Tech., Space Systems Design Lab., Atlanta, GA USA
Improving Conceptual Design for Launch Vehicles. The Bimese Concept: A Study of Mission and Economic Options ***Final Report, 23 Sep. 1996 - 22 Sep. 1999***
Olds, John R., Georgia Inst. of Tech., USA; Tooley, Jeffrey, Georgia Inst. of Tech., USA; Dec. 22, 1999; 98p; In English
Contract(s)/Grant(s): NCC1-229; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This report summarizes key activities conducted in the third and final year of the cooperative agreement NCC1-229 entitled ”Improving Conceptual Design for Launch Vehicles.” This project has been funded by the Vehicle Analysis Branch at NASA’s Langley Research Center in Hampton, VA. Work has been performed by the Space Systems Design Lab (SSDL) at the Georgia Institute of Technology, Atlanta, GA. Accomplishments during the first and second years of this project have been previously reported in annual progress reports. This report will focus on the third and final year of the three year activity.
Author
Aerospace Systems; Launch Vehicles; Rocket Launchers; Rocket Launching; Reusable Launch Vehicles; Booster Rocket Engines

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 and 15 Launch Vehicles and Launch Vehicles, and 18 Spacecraft Design, Testing and Performance. For space suits, see 54 Man/System Technology and Life Support.

20000014438 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-93: Chandra Crew Arrival
Jul. 16, 1999; In English; Videotape: 15 min. 50 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000008141; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

The primary objective of the STS-93 mission was to deploy the Advanced X-ray Astrophysical Facility, which had been renamed the Chandra X-ray Observatory in honor of the late Indian-American Nobel Laureate Subrahmanyan Chandrasekhar. The mission was launched at 12:31 on July 23, 1999 onboard the space shuttle Columbia. The mission was led by Commander Eileen Collins. The crew was Pilot Jeff Ashby and Mission Specialists Cady Coleman, Steve Hawley and Michel Tognini from the Centre National d’Etudes Spatiales (CNES). This videotape shows the astronauts arrival at Kennedy Space Center a week before the launch. Each of the astronauts gives brief remarks, beginning with Eileen Collins, the first woman to command a space mission.
CASI
Astronauts; Spacecrews; Crew Procedures (Preflight)

20000015363 NASA Johnson Space Center, Houston, TX USA
STS 103: Post Flight Crew Presentation
Feb. 09, 2000; In English; Videotape: 15 min., 24 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000015184; JSC-1813; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

The crew (Commander Curtis L. Brown, Pilot Scott J. Kelly, Mission Specialists Steven L. Smith, C. Michael Foale, John M. Grunsfield, Claude Nicollier, and Jean-Francois Clervoy) narrate a video presentation of the STS-103 mission highlights. The mission’s primary objective is servicing the Hubble Space Telescope.
CASI
Space Transportation System Flights; Space Missions; Spacecrews

20000015365 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37 Post-flight Crew Press Conference, Part 2
Apr. 19, 1991; In English; Videotape: 14 min., 10 sec., playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000013420; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

This NASA Kennedy Space Center video release presents a continuation of the April 19, 1991 STS-37 post-flight crew press conference from Johnson Space Center (JSC). Part 2 of the conference continues the question and answer period of Part 1 with Steven R. Nagel, Commander, Kenneth D. Cameron, Pilot, Jerry L. Ross, Mission Specialist 1, Jay Apt, Mission Specialist 2, and Linda M. Godwin, Mission Specialist 3 fielding questions posed by scientific journalists from JSC and other NASA centers. Topics discussed include: the necessary Extravehicular Activity (EVA) to free the Gamma Ray Observatory high gain antenna, communication between Atlantis and space station MIR, HAM radio contacts with Earth, and EVA contingency planning. Part 1 of the press conference can be found in Report Number NONP-NASA-VT-2000013419.
CASI
Space Transportation System Flights; Space Shuttle Missions; Astronauts; Spacecrews

20000015366 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37 Post-flight Crew Press Conference, Part 1
Apr. 19, 1991; In English; Viteotape: 1 hr., 2 min., 11 sec., playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000013419; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS

This NASA Kennedy Space Center video release presents the April 19, 1991 STS-37 post-flight crew press conference from Johnson Space Center (JSC). The video begins with Steven R. Nagel, Commander applauding the efforts of everyone involved in the very smooth shuttle mission and introducing the rest of the crew seated to his right: Kenneth D. Cameron (1), Pilot, Jerry L. Ross, Mission Specialist 1, Jay Apt, Mission Specialist 2, and Linda M. Godwin, Mission Specialist 3. A video presenting mission highlights and on-board activities including liftoff footage, and the deployment of the primary payload, Gamma Ray Observatory (GRO), is shown. The GRO high-gain antenna failed to deploy on command and had to be manually freed and deployed by astronauts Ross and Apt during an unscheduled contingency space walk, the first since April 1985. After the mission summary video is shown, a slide show that includes pictures of Earth from Atlantis, and views of the GRO is presented and is followed by a question and answer period with questions posed by scientific journalists from JSC and other NASA centers. Part 2 of the press conference can be found in Report Number NONP-NASA-VT-2000013420.
CASI
Space Transportation System Flights; Space Shuttle Missions; Astronauts

20000017963 NASA Johnson Space Center, Houston, TX USA
STS-99 Flight Day Highlights and Crew Activities Report
Feb. 12, 2000; In English; Videotape: 16 min. 52 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000015187; BRF-1421B; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

Live footage shows the Blue Team (second of the dual shift crew), Dominic L. Pudwill Gorie, Janice E. Voss and Mamoru Mohri, beginning the first mapping swath covering a 140-mile-wide path. While Mohri conducts mapping operations, Voss and Gorie are seen participating in a news conference with correspondents from NBC and CNN. The Red Team (first of the dual shift crew), Kevin R. Kregel, Janet L. Kavandi and Gerhard P.J. Thiele, relieves the Blue Team and are seen continuing the mapping operations for this around the clock Shuttle Radar Topography Mission (SRTM). Commander Kregel is shown performing boom (mass) durability tests, calibrating the EarthCam Payload, and speaking with the Launch Control Center (LCC) about trouble shooting a bracket for better camera angle.
CASI
Shuttle Imaging Radar; Earth Observations (From Space); Radar Imagery; Radar Maps; Topography; Earth Surface

20000017964 NASA Johnson Space Center, Houston, TX USA
STS-99 Crew Activities Report/Flight Day 1 Highlights
Feb. 11, 2000; In English; Videotape: 20 min. 29 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000015185; BRF-1421A; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

Live footage shows the crew, Commander Kevin R. Kregel, Pilot Dominic L. Pudwill Gorie, and Mission Specialists Janet L. Kavandi, Janice E. Voss, Mamoru Mohri and Gerhard P.J. Thiele, seated in the dining room with the traditional cake. The crew is seen performing various pre-launch activities including suit-up, walk out to the Astro-van, and strap-in into the vehicle. Also seen are the retractions of the orbiter access arm and the gaseous oxygen mint hood, main engine start, booster ignition, liftoff,

and separation of the solid rocket boosters. The Red Team (first of the dual shift crew) includes Kregel, Kavandi, and Thiele, who are shown conducting jet thruster firings, activating radar instruments, and deploying the boom (mass).
CASI
Countdown; Spacecrews; Crew Procedures (Preflight); Liftoff (Launching); Stage Separation; Space Shuttle Boosters

20000019580 NASA Johnson Space Center, Houston, TX USA
STS-95 CEIT in the OPF-2 and the MPPF
Sep. 02, 1998; In English; Videotape: 12 min. 30 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000010626; KSC98-80405; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows the crewmembers of STS-95, Commander Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, Pedro Duque, Payload Specialists Chiaki Mukai and John H. Glenn in a training room talking. Scenes also show the crew in the simulation spacecraft. Crewmembers are seen in the Orbiter Processing Facility Bay 2 ((OPF-2) and the Multi-Payload Processing Facility (MPPF) looking over equipment during the Crew Equipment Interface Test (CEIT) for their mission. The CEIT gives astronauts an opportunity for a hands-on look at the payloads and equipment with which they will be working on orbit.
CASI
Astronaut Training; Training Simulators; Flight Simulation; Flight Training; Spacecraft Equipment

20000019640 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-93 / Columbia Flight Crew Photo Op & QA at Pad for TCDT
Jun. 25, 1999; In English; Videotape: 35 min. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000008132; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

The primary objective of the STS-93 mission was to deploy the Advanced X-ray Astrophysical Facility, which had been renamed the Chandra X-ray Observatory in honor of the late Indian-American Nobel Laureate Subrahmanyan Chandrasekhar. The mission was launched at 12:31 on July 23, 1999 onboard the space shuttle Columbia. The mission was led by Commander Eileen Collins. The crew was Pilot Jeff Ashby and Mission Specialists Cady Coleman, Steve Hawley and Michel Tognini from the Centre National d'Etudes Spatiales (CNES). This videotape shows a pre-flight press conference. Prior to the astronauts' arrival at the bunker area in front of the launch pad, the narrator discusses some of the training that the astronauts are scheduled to have prior to the launch, particularly the emergency egress procedures. Commander Collins introduces the crew and fields questions from the assembled press. Many questions are asked about the experiences of Commander Collins, and Mission Specialist Coleman as women in NASA. The press conference takes place outside in front of the Shuttle Columbia on the launch pad.
CASI
Females; Spacecrews; Crew Procedures (Preflight); Preflight Operations

20000019643 NASA Johnson Space Center, Houston, TX USA
STS-99 Flight Day Highlights 03 and Crew Activities Report
Feb. 13, 2000; In English; Videotape: 18 min. 18 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000015186; BRF-1421C; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

Live footage shows the STS-99's Blue Team Pilot Dominic L. Pudwill Gorie, and Mission Specialist Mamoru Mohri speaking with Dr. Bob Ballard and fielding questions from Fox News Network. During the interviews Janet E. Voss oversees the mapping activities. The Blue Team is also seen speaking with the Launch Control Center (LCC) troubleshooting a problem with a small nitrogen thruster mounted at the tip of the radar's outboard antenna.
CASI
Mapping; Topography; Relief Maps; Earth Surface; Maintenance; Antennas

20000019663 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-96 Flight Crew Press Q & A at KSCNF for TCDT
Apr. 28, 1999; In English; Videotape: 27 min. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000010627; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

Live footage shows Commander of STS-96 mission, Kent V. Rominger, introducing the other crewmembers, Pilot Rick D. Husband, and Mission Specialists Tamara E. Jernigan, Ellen Ochoa, Daniel T. Barry, Julie Payette and Valery Ivanovich Tokarev. During the introduction, Rominger describes each crewmember's responsibilities. He also mentions the deployment of

STARSHINE, and the scheduled space walk with Jernigan and Barry. Panoramic views of the shuttle on the launch pad are also shown.
CASI
Conferences; Discussion; Flight Crews; Crew Procedures (Preflight)

20000019665 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37 Breakfast / Ingress / Launch & ISO Camera Views
Apr. 05, 1991; In English; Videotape: 25 min. playing time, mostly in color, with sound, some black and white footage included
Report No.(s): NONP-NASA-VT-2000013427; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

The primary objective of the STS-37 mission was to deploy the Gamma Ray Observatory. The mission was launched at 9:22:44 am on April 5, 1991, onboard the space shuttle Atlantis. The mission was led by Commander Steven Nagel. The crew was Pilot Kenneth Cameron and Mission Specialists Jerry Ross, Jay Apt, and Linda Godwing. This videotape shows the crew having breakfast on the launch day, with the narrator introducing them. It then shows the crew's final preparations and the entry into the shuttle, while the narrator gives information about each of the crew members. The countdown and launch is shown including the shuttle separation from the solid rocket boosters. The launch is reshown from 17 different camera views. Some of the other camera views were in black and white.
CASI
Space Transportation System; Spacecrews; Space Shuttle Boosters; Prelaunch Summaries; Spacecraft Launching; Launch Vehicles; Launchers

20000019666 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37 Rollout to Pad B
Mar. 15, 1991; In English; Videotape: 50 min. playing time, in color, no sound
Report No.(s): NONP-NASA-VT-2000013430; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

The primary objective of the STS-37 mission was to deploy the Gamma Ray Observatory. The mission was launched at 9:22:44 am on April 5, 1991, onboard the space shuttle Atlantis. The mission was led by Commander Steven R. Nagel. The crew was Pilot Kenneth D. Cameron and Mission Specialists Jerry Ross, Jay Apt, and Linda Godwing. This videotape shows the shuttle being rolled out to the launch pad.
CASI
Space Shuttles; Space Transportation System; Preflight Operations; Launching Pads

20000020690 NASA Glenn Research Center, Cleveland, OH USA
Overview of the HSR Propulsion Program
Peddie, Catherine, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 1-27; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a general overview of the High Speed Research Propulsion Program in viewgraph form. The goals of the program are: 1) to reduce the travel time to the Far East and Europe by 50 percent within 20 years, and do so at today's subsonic ticket prices; 2) Invigorate the general aviation industry, delivering 10,000 aircraft annually within 10 years, and 20,000 aircraft annually within 20 years; and 3) Provide next-generation design tools and experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half.
CASI
General Overviews; High Speed; Aircraft Industry; Civil Aviation; Propulsion System Performance

20000020709 NASA Glenn Research Center, Cleveland, OH USA
BANTAM
Klem, Mark, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 381-395; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The goals of BANTAM (low Cost Booster Technology Program) are to: 1) Reduce the payload cost to orbit by an order of magnitude, from $10,000 to $1,000 per pound, within 10 years and by an additional order of magnitude, from thousands to hundreds of dollars per pound, within 25 years. In-Space, achieve with 15 years, a factor of ten reduction in the cost of Earth orbital transportation, and a factor of two to three reduction in propulsion system mass and travel time required for planetary missions.

Within 25 years, enable bold new missions to the edge of the solar system and beyond by reducing travel times by one to two orders-of magnitude.
CASI
Cost Reduction; Payloads; Propulsion System Performance; Booster Rocket Engines

20000020710 NASA Johnson Space Center, Houston, TX USA
Thermal Protection System Design and Development for the X-38
Kowal, T. John, NASA Johnson Space Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 397-431; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The purpose of the X-38 program is to greatly reduce the costs and schedule for the development of Crew Return Vehicles (CRV's) and Crew Transfer Vehicles (CTV's) through the use of the rapid development methodology associated with an X-project (Ground Testing, Atmospheric Testing and Space Flight Testing).
Derived from text
Thermal Protection; Systems Engineering; X-38 Crew Return Vehicle; Aerodynamic Configurations

20000020755 NASA Johnson Space Center, Houston, TX USA
STS-99: Flight Day 05 Highlights and Crew Activities Report
Feb. 15, 2000; In English; Videotape: 22 min. 44 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000022122; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

During day 5 Endeavour gathers data four times faster than its advanced data communications system can send it to Earth. Pilot Dom Gorie and Mission Specialists Janice Voss and Mamoru Mohri transmit television coverage of Voss using an inflatable globe to explain the mapping of Earth land surfaces. Mohri is shown taking photos out the commander's window, while Gorie is changing a tape on a payload high rate recorder. Mapping operations continued smoothly, with both radar and orbiter systems working flawlessly.
CASI
Space Transportation System; Data Transmission; Television Systems; Spacecrews

20000020774 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-96 Crew Training, Mission Animation, Crew Interviews, STARSHINE, Discovery Rollout and Repair of Hail Damage
May 21, 1999; In English; Videotape: 1 hr. 5 min playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000008128; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS

Live footage shows the crewmembers of STS-96, Commander Kent V. Rominger, Pilot Rick D. Husband, Mission Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette and Valery Ivanovich Tokarev during various training activities. Scenes include astronaut suit-up, EVA training in the Virtual Reality Lab, Orbiter space vision training, bailout training, and crew photo session. Footage also shows individual crew interviews, repair activities to the external fuel tank, and Discovery's return to the launch pad. The engineers are seen sanding, bending, and painting the foam used in repairing the tank. An animation of the deployment of the STARSHINE satellite, International Space Station, and the STS-96 Mission is presented. Footage shows the students from Edgar Allen Poe Middle School sanding, polishing, and inspecting the mirrors for the STARSHINE satellite. Live footage also includes students from St. Michael the Archangel School wearing bunny suits and entering the clean room at Goddard Space Flight Center.
CASI
Astronaut Training; Training Simulators; Flight Simulation; Flight Training; Ejection Training; Bailout; Virtual Reality; Computerized Simulation; Extravehicular Activity; International Space Station

20000020779 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37 Mission Overview: Lead Flight Director Briefing
Feb. 25, 1991; In English; Videotape: 1 hr. 2 min. 34 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000013428; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS

This NASA Kennedy Space Center (KSC) video release presents a Johnson Space Center (JSC) press conference featuring Chuck Shaw, Lead Flight Director discussing the STS-37 Atlantis shuttle mission. Topics presented include overall mission objectives, flight crew, flight directors, primary payload (Gamma Ray Observatory (GRO)), Extravehicular Activities (EVA) Development Flight Experiment (EDFE), secondary payloads, Development Test Objectives (DTO's), Detailed Supplementary Objectives (DSO's), and flight day activities. Certain flight day activities including the Gamma Ray Observatory deployment and

EVA movements and translations are presented as computerized simulations. The video ends with a summary of the key points of STS-37 and a question and answer period with questions posed from Johnson as well as other NASA centers. Questions include topics involving EVA safety, emergency EVA's, and what determines the day of primary payload deployment.
CASI
Space Transportation System Flights; Gamma Ray Observatory; Extravehicular Activity

20000020788 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-96 TCDT Crew Arrival
Apr. 28, 1999; In English; Videotape: 9 min. 15 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000010632; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows the crewmembers of STS-96, Commander Kent V. Rominger, Pilot Rick D. Husband, Missions Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette and Valery Ivanovich Tokarev, arriving at the Shuttle Landing Facility in T-38 aircraft for Terminal Countdown Demonstration Test (TCDT) activities. Rominger speaks briefly to introduce the other crewmembers and their designated responsibilities.
CASI
Crew Procedures (Preflight); Astronaut Training; T-38 Aircraft; Arrivals; Landing

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.

20000015411 National Defence Research Establishment, Div. of Defence Analysis, Stockholm, Sweden
SAM-Defence against Cruise Missiles and Ballistic Missiles with Limited Range (TSA-LV) ***Luftvaernsskydd mot Kryssningsrobotar och Ballistiska Robotar med Begraensad Raeckvidd (TSA-LV)***
Hansson, M. B.; Tarras-Wahlberg, E.; Dec. 1998; 100p; In Swedish
Report No.(s): PB2000-101440; FOA-R-98-00898-170-SE; No Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

At order of Swedish Government Director Research Institute (FOA) has done a broad held study of SAM-system effects against CM and short range BM. For CM with radar cross-section 0.1 sqM or more, SAM-systems with limited range have good effects in Swedish terrain types, HAWK has good effect, but only when fire units are not limited by masking, and fighter defense has good effects providing appropriate C41-system. For CM cross-section 0.01 sqM or less, no air defense system in the Swedish defense is adapted to this threat today. CM with high speed and BM with limited range, PATRIOT PAC-3 has good autonomous effects providing the fire unit gets a suitable search radar, and HAWK has effects providing co-operation with PATRIOT PAC-3 or gets its own expanded fire control system. For new ideas about control systems, a movable, common control system for the Swedish total defense has been roughly described with aerostates, UAV and IR-sensors on masts. For studies of Swedish air defense systems in international operations, a fighter defense must have a sufficient deep of operation area to be effective, and no air defense can guarantee that no CM or BM will reach its target. Guaranties must therefore exist for retaliation. For Future studies, more thoroughly made studies ought to be done when more knowledge about long range SAM-systems has been collected.
NTIS
Cruise Missiles; Ballistic Missiles; Defense Program; Antimissile Defense

20000017933 GTE Technology Organization, Cleveland, OH USA
PNNI Performance Validation Test Report
Dimond, Robert P., GTE Technology Organization, USA; December 1999; 22p; In English
Contract(s)/Grant(s): NAS3-99175; RTOP 632-50-5A
Report No.(s): NASA/CR-1999-209412; E-11974; NAS 1.26:209412; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Available from CASI only as part of the entire parent document; Available from CASI only as part of the entire parent document

Two Private Network-Network Interface (PNNI) neighboring peers were monitored with a protocol analyzer to understand and document how PNNI works with regards to initialization and recovery processes. With the processes documented, pertinent events were found and measured to determine the protocols behavior in several environments, which consisted of congestion

and/or delay. Subsequent testing, of the protocol in these environments was conducted to determine the protocol's suitability for use in satellite-terrestrial network architectures.
Author
Satellite Networks; Performance Tests; Satellite Transmission; Asynchronous Transfer Mode

20000020675 NASA Ames Research Center, Moffett Field, CA USA
Biotelemetry
Mundt, C., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 580; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sensors 2000! is developing pill-shaped biotelemeters for measuring physiological parameters during space flight life sciences experiments using rodents aboard the ISS Gravitational Biology Facility, with the additional capability for monitoring the health of astronauts in the Human Research Facility. The first "pill transmitter" is capable of measuring pressure and temperature for up to 10 months. The NASA objective is to utilize these devices. The pill-transmitters can also be used by non-NASA users for medical applications. One application is fetal surgery. The 44pill" is small enough to be endoscopically placed into the womb through a tube used during surgeries to correct fetal defects before birth. After surgery, the pill-transmitter will continue to monitor body temperature, pressure and other vital signs in the womb, radioing results to physicians. It will help them to detect preterm-labor, a serious problem after fetal surgery. The pill is about one-third-of-an-inch across and one-and-one-third-inches long. Future pill-versions will include pH, heartrate, and ECG. A pH-pill prototype is currently being tested. Sensors 2000! has also designed and built a 2-channel biotelemetry receiver and has developed data acquisition software to display and record the measured physiological parameters. A DSP-base hand-held receiver (trisponder) is currently under development.
Author
Biotelemetry; Body Temperature; Data Acquisition; Electrocardiography; Gravitational Physiology; Heart Rate; pH; Pressure Measurement; Transmitters

20000020678 NASA Ames Research Center, Moffett Field, CA USA
Neurolab Biotelemetry System (NBS)
Schonfeld, J., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 584; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This system was developed by the Sensors 2000! Program (S2K!) at Ames Research Center for the E132 STS-90 Neurolab Shuttle mission experiment to monitor 12 untethered adult male rats housed in the Research Animal Habitat Facility (RAHF). The system monitored the animals for body temperature, heart rate, and activity, and stored the data on board for up to 21 days for downloading after landing. The principal investigator's monitoring requirements were accomplished integrating a combination of both commercial and in-house developed hardware and software, including an off-the-shelf implantable telemetry transmitter and receiver system. In addition, a custom-developed antenna system was incorporated into the RAHF cages to perform the unique function of near-field radio-frequency (rf) measurement in the metal cages. This system proved the ability to perform wireless physiological measurements in very non-ideal circumstances using existing habitats and cabling without interfering with other experiment or shuttle systems. S2K! is continuing development on a custom telemetry transmitter and receiver system which will expand measurement capabilities.
Author
Product Development; Space Transportation System; Tethering; Biotelemetry; Body Temperature; Frequency Measurement; Heart Rate; Telemetry; Transmitter Receivers

18
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.

20000014440 New Mexico State Univ., Klipsch School of Electrical and Computer Engineering, Las Cruces, NM USA
Small Satellite Access of the Space Network
Horan, Stephen, New Mexico State Univ., USA; Minnix, Timothy O., Hughes Communications, Inc., USA; Vigil, J. S.,

Honeywell, Inc., USA; IEEE Transactions on Aerospace and Electronic Systems; October 1999; ISSN 0018-9251; Volume 35, No. 4, pp. 1173-1182; In English; Sponsored by Institute of Electrical and Electronic Engineers, USA
Contract(s)/Grant(s): NAG5-1491; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Small satellites have been perceived as having limited access to NASA's Space Network (SN). The potential for satellite access of the space network when the design utilizes a fixed antenna configuration and low-power, coded transmission is analyzed. From the analysis, satellites using this configuration in high-inclination orbits are shown to have a daily data throughput in the 100 to 1000 Mbit range using the multiple access communications service.
Author
Satellite Networks; Communication Networks; Satellite Transmission; Multiple Access; Access Control; Pulse Communication; Satellite Communication; Communication Satellites

20000017958 NASA Marshall Space Flight Center, Huntsville, AL USA
Lightning Protection Guidelines for Aerospace Vehicles
Goodloe, C. C., NASA Marshall Space Flight Center, USA; October 1999; 1p; In English
Report No.(s): NASA/TM-1999-209734; NAS 1.15:209734; M-946; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

This technical memorandum provides lightning protection engineering guidelines and technical procedures used by the George C. Marshall Space Flight Center (MSFC) Electromagnetics and Aerospace Environments Branch for aerospace vehicles. The overviews illustrate the technical support available to project managers, chief engineers, and design engineers to ensure that aerospace vehicles managed by MSFC are adequately protected from direct and indirect effects of lightning. Generic descriptions of the lightning environment and vehicle protection technical processes are presented. More specific aerospace vehicle requirements for lightning protection design, performance, and interface characteristics are available upon request to the MSFC Electromagnetics and Aerospace Environments Branch, mail code EL23.
Author
Aerospace Vehicles; Lightning; Atmospheric Electricity; Protection

20000021012 Department of Defense, Office of Inspector General, Arlington, VA USA
Commercial Satellite Leased Capacity
Mar. 26, 1999; 72p; In English
Contract(s)/Grant(s): Proj. 6RD-0056.03
Report No.(s): AD-A367031; IG/DOD-99-111; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This report is the fourth in a series resulting from our audit, "Communications Capability Within DoD to Support Two Major Regional Conflicts Nearly Simultaneously." This report discusses the management, procurement, and usage of commercial satellite systems within the DoD. Report No. 97-187, "Communications Capability Within DoD to Support Two Major Regional Conflicts Nearly Simultaneously," July 14,1997, discusses military satellite communications and the requirements determination process for deliberate planning related to the national military strategy. Report No. 98-009, "Demand Assigned Multiple Access Terminals," October 14, 1997, discusses the management of the fielding and funding of multiple access terminals. Report No. 99-009, "Coordination of Electromagnetic Frequency Spectrum and International Telecommunications Agreements," October 9, 1998, discusses the coordination of electromagnetic frequency spectrum and the management of international telecommunications agreements.
DTIC
Satellite Communication; Procurement; Telecommunication; Commerce; Military Spacecraft

19
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 Aircraft Instrumentation and Avionics; For spaceborne instruments not integral to the vehicle itself see 35 Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy, Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy.

20000020680 NASA Ames Research Center, Moffett Field, CA USA
Bion-11 Spaceflight Mission
Skidmore, M., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 586; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Sensors 2000! Program, in support of the Space Life Sciences Payloads Office at NASA Ames Research Center developed a suite of bioinstrumentation hardware for use on the Joint US/Russian Bion I I Biosatellite Mission (December 24, 1996 - January 7, 1997). This spaceflight included 20 separate experiments that were organized into a complimentary and interrelated whole, and performed by teams of US, Russian, and French investigators. Over 40 separate parameters were recorded in-flight on both analog and digital recording media for later analysis. These parameters included; Electromyogram (7 ch), Electrogastrogram, Electrooculogram (2 ch), ECG/EKG, Electroencephlogram (2 ch), single fiber firing of Neurovestibular afferent nerves (7 ch), Tendon Force, Head Motion Velocity (pitch & yaw), P02 (in vivo & ambient), temperature (deep body, skin, & ambient), and multiple animal and spacecraft performance parameters for a total of 45 channels of recorded data. Building on the close cooperation of previous missions, US and Russian engineers jointly developed, integrated, and tested the physiologic instrumentation and data recording system. For the first time US developed hardware replaced elements of the Russian systems resulting in a US/Russian hybrid instrumentation and data system that functioned flawlessly during the 14 day mission.
Author
Aerospace Engineering; Ambient Temperature; Bioinstrumentation; Biosatellites; Data Recording; Electrocardiography; Electromyography; Spacecraft Performance

20
SPACECRAFT PROPULSION AND POWER

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

20000014439 NASA Goddard Space Flight Center, Greenbelt, MD USA
Design Challenges of Power Systems for Instrumented Spacecraft with Very Low Perigees in the Earth's Ionosphere
Moran, Vickie Eakin, NASA Goddard Space Flight Center, USA; Manzer, Dominic D., NASA Goddard Space Flight Center, USA; Pfaff, Robert E., NASA Goddard Space Flight Center, USA; Grebowsky, Joseph M., NASA Goddard Space Flight Center, USA; Gervin, Jan C., NASA Goddard Space Flight Center, USA; Dec. 06, 1999; 7p; In English, Dec. 1999, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Designing a solar array to power a spacecraft bus supporting a set of instruments making in situ plasma and neutral atmosphere measurements in the ionosphere at altitudes of 120km or lower poses several challenges. The driving scientific requirements are the field-of-view constraints of the instruments resulting in a three-axis stabilized spacecraft, the need for an electromagnetically unperturbed environment accomplished by designing an electrostatically conducting solar array surface to avoid large potentials, making the spacecraft body as small and as symmetric as possible, and body-mounting the solar array. Furthermore, the life and thermal constraints, in the midst of the effects of the dense atmosphere at low altitude, drive the cross-sectional area of the spacecraft to be small particularly normal to the ram direction. Widely varying sun angles and eclipse durations add further complications, as does the growing desire for multiple spacecraft to resolve spatial and temporal variations packaged into a single launch vehicle. Novel approaches to insure adequate orbit-averaged power levels of approximately 250W include an oval-shaped cross section to increase the solar array collecting area during noon-midnight orbits and the use of a flywheel energy storage system. The flywheel could also be used to help maintain the spacecraft's attitude, particularly during excursions to the lowest

perigee altitudes. This paper discusses the approaches used in conceptual power designs for both the proposed Dipper and the Global Electrodynamics Connections (GEC) Mission currently being studied at the NASA/Goddard Space Flight Center.
Author
Design Analysis; Solar Arrays; Power Modules (STS); Propulsion System Configurations; Large Space Structures; Launch Vehicles; Aerospace Vehicles; Perigees; Energy Storage; Flywheels

20000014448 Illinois Univ. at Urbana-Champaign, Dept. of Aeronautical and Astronautical Engineering, Urbana, IL USA
Plasma Processes in Pulsed Plasma Microthrusters ***Final Report, 15 Feb. 1997 - 15 Dec. 1998***
Burton, Rodney L.; Wilson, M. J.; Bushman, S. S.; Antonsen, E. A.; Sep. 1999; 69p; In English
Contract(s)/Grant(s): F49620-97-J-0138
Report No.(s): AD-A371805; UILU-ENG-99-0515; AAE-99-15; AFRL-SR-BL-TR-99-0303; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This final technical report summarizes research on low-power pulsed Teflon(Trademark) plasma propulsion for satellites. Section I discusses a compact thrust stand used to make thrust and impulse bit measurements. Section II describes experimental measurements on a gasdynamic-type PPT in which measurements of magnetic field, electron number density, electron temperature, ion speed ratio and gas velocity are carried out by magnetic and advanced Langmuir probes. This section also describes thrust and heat-loss measurements. Section III outlines research with an electromagnetic-type PPT, intended to achieve very high specific impulse and efficiency.
DTIC
Plasma Propulsion; Plasmas (Physics); Microrocket Engines; Plasma Engines; Rocket Engines

20000017931 NASA Glenn Research Center, Cleveland, OH USA
Advanced Electric Propulsion for RLV Launched Geosynchronous Spacecraft
Oleson, Steven, NASA Glenn Research Center, USA; December 1999; 16p; In English; 26th; 26th International Electric Propulsion Conference, 17-21 Oct. 1999, Kitakyushu, Japan; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 632-1B-1C
Report No.(s): NASA/TM-1999-209646; NAS 1.15:209646; IEPC-99-185; E-11994; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Solar Electric Propulsion (SEP) when used for station keeping and final orbit insertion has been shown to increase a geostationary satellite's payload when launched by existing expendable launch vehicles. In the case of reusable launch vehicles or expendable launch vehicles where an upper stage is an expensive option, this methodology can be modified by using the existing on-board apogee chemical system to perform a perigee burn and then letting the electric propulsion system complete the transfer to geostationary orbit. The elimination of upper stages using on-board chemical and electric propulsion systems was thus examined for GEO spacecraft. Launch vehicle step-down from an Atlas IIAR to a Delta 7920 (no upper stage) was achieved using expanded on-board chemical tanks, 40 kW payload power for electric propulsion, and a 60 day elliptical to GEO SEP orbit insertion. Optimal combined chemical and electric trajectories were found using SEPSPOT. While Hall and ion thrusters provided launch vehicle step-down and even more payload for longer insertion times, NH3 arcjets had insufficient performance to allow launch vehicle step-down. Degradation levels were only 5% to 7% for launch step-down cases using advanced solar arrays. Results were parameterized to allow comparisons for future reusable launch vehicles. Results showed that for an 8 W/kg initial power/launch mass power density spacecraft, 50% to 100% more payload can be launched using this method.
Author
Electric Propulsion; Propulsion System Configurations; Propulsion System Performance; Spacecraft Propulsion; Reusable Launch Vehicles; Geosynchronous Orbits; Synchronous Platforms; Synchronous Satellites

20000017997 Thiokol Propulsion, RSRM Engineering, Brigham City, UT USA
Analyzing the Space Shuttle's Reusable Solid Rocket Motor's Nozzle-to-Case Joint
Knight, Benjamin D., Thiokol Propulsion, USA; [2000]; 31p; In English; ANSYS Users, 28-30 Aug. 2000, Pittsburgh, PA, USA
Contract(s)/Grant(s): NAS8-38100; Copyright; Avail: Issuing Activity, Hardcopy

On the Space Shuttle's reusable solid rocket motors (RSRM), the nozzle-to-case joint contains primary and secondary o-ring seals. These 0-ring seals must be capable of maintaining a seal during the rapid pressurization of the motor. During this initial pressurization, the deflection and rotation of the nozzle-to-case joint tends to pull apart the seal surfaces. In order to maintain a seal, the initially compressed o-ring must follow (or track) the seal surfaces as they move apart. A safe design is achieved when the opening of the seal groove (gap opening) is less than the tracking capability of the o-ring. To verify that the joint is safe under various dimensional variations and defects, a parametric finite element model was developed. The model was incorporated into

ANSYS using the ANSYS parametric design language (APDL). A 1.8-degree cylindrical segment with symmetrical boundary conditions was used to represent the joint.The joint model consists of an assembly of five parts connected with surface-to-surface contact elements. While the joint was modeled with 3-13 solid elements, it was also attached to an axisymmetric model of the nozzle. By applying pressure to the nozzle model, the load was transferred to the nozzle-to-case joint. This parametric model provided a method to predict the gap openings of the seal groove. This parametric model has provided a relatively easy method to analyze the effect different parameters have on seal gap openings. The seal gap openings were studied with varying bolt preloads, pressures, and the use of a short radial bolt. to study the effect of the short radial bolt, the model was converted into a 7.2-degree segment, containing 206,000 degrees of freedom. In this larger model, only one out of the three radial bolts is replaced with a short bolt. This shorter bolt and lower accompanying preload have a tendency to increase the seal gap opening. The model has also been used to analyze the joint using aft domes which fall outside of the engineering specifications. A slight variation in the dome's profile increased the gap opening of the seal, but not significantly. For each of the variations analyzed, the predicted seal gap openings have shown that the hardware is safe for flight.
Author
Reusable Rocket Engines; Space Shuttles

20000018014 NASA Marshall Space Flight Center, Huntsville, AL USA
Performance Optimization of the Gasdynamic Mirror Propulsion System
Emrich, William J., Jr., NASA Marshall Space Flight Center, USA; Kammash, Terry, Michigan Univ., USA; [1999]; 5p; In English; Space Technology and Applications International Forum-2000, 31 Jan. - 4 Feb. 2000, Albuquerque, NM, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Nuclear fusion appears to be a most promising concept for producing extremely high specific impulse rocket engines. Engines such as these would effectively open up the solar system to human exploration and would virtually eliminate launch window restrictions. A preliminary vehicle sizing and mission study was performed based on the conceptual design of a Gasdynamic Mirror (GDM) fusion propulsion system. This study indicated that the potential specific impulse for this engine is approximately 142,000 sec. with about 22,100 N of thrust using a deuterium-tritium fuel cycle. The engine weight inclusive of the power conversion system was optimized around an allowable engine mass of 1500 Mg assuming advanced superconducting magnets and a Field Reversed Configuration (FRC) end plug at the mirrors. The vehicle habitat, lander, and structural weights are based on a NASA Mars mission study which assumes the use of nuclear thermal propulsion' Several manned missions to various planets were analyzed to determine fuel requirements and launch windows. For all fusion propulsion cases studied, the fuel weight remained a minor component of the total system weight regardless of when the missions commenced. In other words, the use of fusion propulsion virtually eliminates all mission window constraints and effectively allows unlimited manned exploration of the entire solar system. It also mitigates the need to have a large space infrastructure which would be required to support the transfer of massive amounts of fuel and supplies to lower a performing spacecraft.
Author
Nuclear Propulsion; Mirror Fusion; Nuclear Fusion; Rocket Engines

20000018019 NASA Glenn Research Center, Cleveland, OH USA
Solar Stirling for Deep Space Applications
Mason, Lee S., NASA Glenn Research Center, USA; December 1999; 12p; In English; Space Technology and Applications International Forum, 30 Jan. - 3 Feb. 2000, Albuquerque, NM, USA; Sponsored by American Inst. of Physics, USA
Contract(s)/Grant(s): RTOP 632-1A-1K
Report No.(s): NASA/TM-1999-209656; E-12012; NAS 1.15:209656; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study was performed to quantify the performance of solar thermal power systems for deep space planetary missions. The study incorporated projected advances in solar concentrator and energy conversion technologies. These technologies included inflatable structures, lightweight primary concentrators, high efficiency secondary concentrators, and high efficiency Stirling convertors. Analyses were performed to determine the mass and deployed area of multi-hundred watt solar thermal power systems for missions out to 40 astronomical units. Emphasis was given to system optimization, parametric sensitivity analyses, and concentrator configuration comparisons. The results indicated that solar thermal power systems are a competitive alternative to radioisotope systems out to 10 astronomical units without the cost or safety implications associated with nuclear sources.
Author
Solar Thermal Electric Power Plants; Deep Space; Stirling Cycle; Energy Conversion

20000019619 Aerospace Corp., El Segundo, CA USA

Graphite Epoxy Motor Case Impact Monitoring and Reference Strain Measurement Using Conventional Resistance Strain Gages

Wiedeman, L. H.; Aug. 30, 1999; 17p; In English

Contract(s)/Grant(s): F04701-93-C-0094

Report No.(s): AD-A370952; TR-99(1222)-1; SMC-TR-99-26; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of low-energy impacts (below damage threshold) was monitored on subject graphite epoxy motor cases using conventional strain gages. Similar impact tests were done on an empty case and a Delta GEM inert-propellant-loaded case. The conventional strain gages were also used to monitor case bending during lifting, handling, and transportation shock exercises. The impact test energies ranged between 1 and 6 ft-lb with a 5/8-in. tup. The 6 ft-lb impacts impart a sufficiently large strain wave to be sensed by all gages on the inert loaded motor, regardless of location or orientation. This includes impacts on the cork covering. However, the strain signals for some of the remote impacts are pushing the lower limit of detection for this system (1 micro-strain). Typical strains measured for a 6 ft-lb impact on the inert-loaded case were 15 micro-strain where the gage was located 17 in. from the impact. The strain impulse damping with distance is roughly exponential for the sharp impulse and very slight for the lower-frequency ringing. The strain waves have remarkably reproducible amplitudes and shapes for successive impacts at a given location and energy. However, the recorded waves are dependent on factors such as the orientation of the gage with respect to the case (axial vs. circumferential), the mode and direction of the wave propagation, and the location of the impact. These factors make it difficult to predict the exact wave shape for an arbitrary combination of impact location and gage orientation. The lifting exercises produced strain signals of 200 to 500 micro-strain, which are much larger than the impact strain signals. The strapping of the motor to the truck bed also imposed a significant strain offset (80 micro-strain) to the dynamic signal monitoring. Running the truck over a series of wooden 2 x 4's produced dynamic strain oscillations of +/- 100 micro-strain with a nominal bandwidth of 10 Hz.

DTIC

Impact Tests; Strain Gages; Solid Propellant Rocket Engines; Graphite-Epoxy Composites; Strain Measurement

20000019655 NASA Marshall Space Flight Center, Huntsville, AL USA

Flow Simulation of Solid Rocket Motors, 1, Injection Induced Water-Flow Tests from Porous Media

Ramachandran, N., Universities Space Research Association, USA; Yeh, Y. P., Cray Research, Inc., USA; Smith, A. W., NASA Marshall Space Flight Center, USA; Heaman, J. P., NASA Marshall Space Flight Center, USA; 1999; 2p; In English

Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Prior to selecting a proper porous material for use in simulating the internal port flow of a solid rocket motor (SRM), in cold-flow testing, the flow emerging from porous materials is experimentally investigated. The injection-flow emerging from a porous matrix always exhibits a lumpy velocity profile that is spatially stable and affects the development of the longitudinal port flow. This flow instability, termed pseudoturbulence, is an inherent signature of the porous matrix and is found to generally increase with the wall porosity and with the injection flow rate. Visualization studies further show that the flow from porous walls made from shaving-type material (sintered stainless-steel) exhibits strong recirculation zones that are conspicuously absent in walls made from nodular or spherical material (sintered bronze). Detailed flow visualization observations and hot-film measurements are reported from tests of injection-flow and a coupled cross-flow from different porous wall materials. Based on the experimental data, discussion is provided on the choice of suitable material for SRM model testing while addressing the consequences and shortcomings from such a test.

Author

Internal Flow; Simulation; Solid Propellant Rocket Engines; Cold Flow Tests

20000020699 NASA Glenn Research Center, Cleveland, OH USA

Feasibility Assessment of Thermal Barriers for RSRM Nozzle Joint Locations

Steinetz, Bruce M., NASA Glenn Research Center, USA; Dunlap, Patrick H., Jr., Modern Technologies Corp., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 205-217; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Solid rockets, including the Space Shuttle solid rocket motor, are generally manufactured in large segments which are then shipped to their final destination where they are assembled. These large segments are sealed with a system of primary and secondary 0-rings to contain combustion gases inside the rocket which are at pressures of up to 900 psi and temperatures of up to 5500 F. The seals are protected from hot combustion gases by thick layers of phenolic insulation and by joint-filling compounds between these layers. Recently, though, routine inspections of nozzle-to-case joints in the Shuttle solid rocket motors during disassembly revealed erosion of the primary O-rings. Jets of hot gas leaked through gaps in the joint-filling compound between

the layers of insulation and impinged on the O-rings. This is not supposed to take place, so NASA and Thiokol, the manufacturer of the rockets, initiated an investigation and found that design improvements could be made in this joint. One such improvement would involve using NASA Lewis braided thermal barriers as another level of protection for the O-ring seals against the hot combustion gases.
Derived from text
Feasibility Analysis; Space Shuttle Boosters; Thermal Insulation; Position (Location); Seals (Stoppers)

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 24 through 29. For astrochemistry see category 90 Astrophysics.

20000015384 ERES Consultants, Inc., Champaign, IL USA
LTPP Pavement Maintenance Materials: SPS-4 Supplemental Joint Seal Experiment ***Final Report, Oct. 1993 - Jun. 1999***
Smith, K. L.; Pozsgay, M. A.; Evans, L. D.; Romine, A. R.; Oct. 1999; 178p; In English
Report No.(s): PB2000-100914; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The Strategic Highway Research Program (SHRP) Specific Pavement Studies (SPS)-4 preventive maintenance experiment was established to determine the benefits and cost-effectiveness of concrete maintenance activities, such as joint sealing and slab under sealing. Since 1989, several test sites have been constructed throughout the United State for this purpose. This report documents the entire SPS-4 supplemental joint seal study, including the installation of 29 unique joint seal treatment, the laboratory testing of experimental sealant materials, and the multi-year performance monitoring of the various joint seal treatments. It also discusses the results of comprehensive statistical analyses conducted on sealant material performance.
NTIS
Maintenance; Pavements

20000018015 NASA Glenn Research Center, Cleveland, OH USA
Intercalation of Lithium in Pitch-Based Graphitized Carbon Fibers Chemically Modified by Fluorine: Soft Carbon With or Without an Oxide Surface
Hung, Ching-Chen, NASA Glenn Research Center, USA; Prisko, Aniko, Cleveland State Univ., USA; December 1999; 18p; In English; Carbon, 11-16 Jul. 1999, Charleston, SC, USA; Sponsored by American Ceramic Society, USA
Contract(s)/Grant(s): RTOP 632-1A-1E
Report No.(s): NASA/TM-1999-209437; E-11914; NAS 1.15:209437; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of carbon structure and surface oxygen on the carbon's performance as the anode in lithium-ion battery were studied. Two carbon materials were used for the electrochemical tests: soft carbon made from defluorination of graphite fluoride, and the carbon precursor from which the graphite fluoride was made. In this research the precursor was graphitized carbon fiber P-100. It was first fluorinated to form CF(0.68), then defluorinated slowly at 350 to 450 C in bromoform, and finally heated in 1000 C nitrogen before exposed to room temperature air, producing disordered soft carbon having basic surface oxides. This process caused very little carbon loss. The electrochemical test involved cycles of lithium intercalation and deintercalation using C/saturated LiI-50/50 (vol %) EC and DMC/Li half cell. The cycling test had four major results. (1) The presence of a basic oxide surface may prevent solvent from entering the carbon structure and therefore prolong the carbon's cycle life for lithium intercalation-deintercalation. (2) The disordered soft carbon can store lithium through two different mechanisms. One of them is lithium intercalation. which gives the disordered carbon an electrochemical behavior similar to its more ordered graphitic precursor. The other is unknown in its chemistry, but is responsible for the high-N,oltage portion (less than 0.3V) of the charge-discharge curve. (3) Under certain conditions, the disordered carbon can store more lithium than its precursor. (4) These sample and its precursor can intercalate at 200 mA/g. and deintercalate at a rate of 2000 mA/g without significant capacity loss.
Author
Lithium; Fluorides; Carbon; Intercalation; Carbon Fibers; Defluorination

20000020750 Sandia National Labs., Albuquerque, NM USA
Dynamic Properties of Tributyl Phosphate
Chhabildas, L. C.; Grady, D. E.; Reinhart, W. D.; Winfree, N. A.; Jun. 23, 1999; 6p; In English; APS SCCM 99: Shock

Compression of Condensed Matter, 27 Jun. - 2 Jul. 1999, Snowbird, UT, USA
Report No.(s): DE00-008455; SAND99-1461C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Controlled impact methodology has been used on the powdergun to obtain dynamic behavior properties of tributylphosphate (TBP). A novel test methodology is used to provide extremely accurate equation of state data of the liquid from 0.3 GPa to 13 GPa. The thin aluminum plate used for confining the liquid also serves as a diagnostic to provide (1) the reshock state from 0.6 GPa to 28 GPa and (2) subsequent release adiabats born the reshocked state. The test methodology and the results are presented in this paper.
NTIS
Phosphates; Dynamic Characteristics; Aluminum; Impact Tests

20000020759 Idaho National Engineering Lab., Idaho Falls, ID USA
Lessons Learned from Drop Testing
Ware, A. G.; Morton, D. K.; Smith, N. L.; Snow, S. D.; Rahl, T. E.; Aug. 01, 1999; 8p; In English; ASME Pressure Vessel and Piping Conference, 1-4 Aug. 1999, Boston, MA, USA
Report No.(s): DE00-007639; INEEL/CON-99-00137; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Department of Energy (DOE) has developed a set of standard canister for the handling, interim storage, transportation, and disposal in the national repository of DOE spent nuclear fuel (SNF). The canister was developed to withstand a drop from 30 feet onto a rigid (flat) surface, sustaining only minor damage - but no rupture - to the pressure (containment) boundary. The design concept was validated through a drop testing program and finite element analyses. The drop-testing program consisted of seven drop tests of smaller test specimens and five drop tests of full-scale representative canisters. This paper addresses fabrication of the test specimens, instrumentation, data acquisition, data processing, and details of the actual drops. The authors discuss the problems encountered during the test program, the solutions applied, and some lessons learned. For seasoned drop test engineers, many of the things presented in this paper may seem trivial or obvious. This paper is mainly for those embarking on their first drop test program. It is hoped the information presented herein will make their first drop test go smoother. It is the simple, overlooked things that tend to cause problems on test day, rather than the obvious, complicated problems that have been well thought out prior to test day.
NTIS
Drop Tests; Flat Surfaces; Containment; Data Acquisition; Data Processing

24
COMPOSITE MATERIALS

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

20000015404 Virginia Univ., School of Engineering and Applied Science, Charlottesville, VA USA
Hierarchical Adaptive Modeling ***Final Report, 1 Sep. 986-31 Aug. 1999***
Noor, Ahmed K.; Perry, Ferman W.; Nov. 1999; 307p; In English
Contract(s)/Grant(s): F49620-6-1-0462
Report No.(s): AD-A371408; UVA/525856/CE00/101; AFRL-SR-BL-TR-99-0283; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Computational procedures are developed for evaluating the hierarchical sensitivity coefficients of the nonlinear response of composite and sandwich structures. The hierarchical sensitivity coefficients measure the sensitivity of the response to three sets of interrelated parameters; namely, panels (or shells), layer and micromechanical parameters. The computational procedure is applied to the nonlinear static and postbuckling responses of composite shells and panels, as well as to sandwich structures with composite face sheets. The sensitivity coefficients are used in conjunction with fuzzy set techniques to study the range of variation of various response quantities associated with pre-selected variations of the major parameters.
DTIC
Composite Structures; Failure; Models; Shells (Structural Forms); Nonlinearity

20000017962 NASA Langley Research Center, Hampton, VA USA
Influence of Ply Waviness on Fatigue Life of Tapered Composite Flexbeam Laminates
Murri, Gretchen B., Army Research Lab., USA; December 1999; 39p; In English; ASTM Symposium Composite Structures: Theory and Practice, 17-18 May 1999, Seattle, WA, USA; Sponsored by American Society for Testing and Materials, USA

Contract(s)/Grant(s): RTOP 581-10-21-01
Report No.(s): NASA/TM-1999-209830; NAS 1.15:209830; ARL-TR-2110; L-17908; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Nonlinear tapered flexbeam laminates, with significant ply waviness, were cut from a full-size composite rotor hub flexbeam. The specimens were tested under combined axial tension and cyclic bending loads. All of the specimens had wavy plies through the center and near the surfaces (termed marcelled areas), although for some of the specimens the surface marcels were very obvious, and for others they were much smaller. The specimens failed by first developing cracks through the marcels at the surfaces, and then delaminations grew from those cracks, in both directions. Delamination failure occurred in these specimens at significantly shorter fatigue lives than similar specimens without waviness, tested in ref. 2. A 2D finite element model was developed which closely approximated the flexbeam geometry, boundary conditions, and loading. In addition, the FE model duplicated the waviness observed in one of the test specimens. The model was analyzed using a geometrically nonlinear FE code. Modifications were made to the original model to reduce the amplitude of the marcels near the surfaces. The analysis was repeated for each modification. Comparisons of the interlaminar normal stresses, sigma(sub n), in the various models showed that under combined axial-tension and cyclic-bending loading, for marcels of the same aspect ratio, sigma(sub n) stresses increased as the distance along the taper, from thick to thin end, increased. For marcels of the same aspect ratio and at the same X-location along the taper, sigma(sub n) stresses decreased as the distance from the surface into the flexbeam interior increased. A technique was presented for determining the smallest acceptable marcel aspect ratio at various locations in the flexbeam.
Author
Fatigue Life; Interlaminar Stress; Laminates; Stress-Strain Relationships; Stress Distribution; Strain Distribution; Composite Materials

20000018017 NASA Glenn Research Center, Cleveland, OH USA
Strain Rate Dependent Deformation and Strength Modeling of a Polymer Matrix Composite Utilizing a Micromechanics Approach
Goldberg, Robert K., NASA Glenn Research Center, USA; December 1999; 88p; In English
Contract(s)/Grant(s): RTOP 523-24-13
Report No.(s): NASA/TM-1999-209768; E-12046; NAS 1.15:209768; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Potential gas turbine applications will expose polymer matrix composites to very high strain rate loading conditions, requiring an ability to understand and predict the material behavior under extreme conditions. Specifically, analytical methods designed for these applications must have the capability of properly capturing the strain rate sensitivities and nonlinearities that are present in the material response. The Ramaswamy-Stouffer constitutive equations, originally developed to analyze the viscoplastic deformation of metals, have been modified to simulate the nonlinear deformation response of ductile, crystalline polymers. The constitutive model is characterized and correlated for two representative ductile polymers. Fiberite 977-2 and PEEK, and the computed results correlate well with experimental values. The polymer constitutive equations are implemented in a mechanics of materials based composite micromechanics model to predict the nonlinear, rate dependent deformation response of a composite ply. Uniform stress and uniform strain assumptions are applied to compute the effective stresses of a composite unit cell from the applied strains. The micromechanics equations are successfully verified for two polymer matrix composites. IM7/977-2 and AS4/PEEK. The ultimate strength of a composite ply is predicted with the Hashin failure criteria that were implemented in the composite micromechanics model. The failure stresses of the two composite material systems are accurately predicted for a variety of fiber orientations and strain rates. The composite deformation model is implemented in LS-DYNA, a commercially available transient dynamic explicit finite element code. The matrix constitutive equations are converted into an incremental form, and the model is implemented into LS-DYNA through the use of a user defined material subroutine. The deformation response of a bulk polymer and a polymer matrix composite are predicted by finite element analyses. The results compare reasonably well to experimental values, with some discrepancies. The discrepancies are at least partially caused by the method used to integrate the rate equations in the polymer constitutive model.
Author
Stress-Strain Relationships; Polymer Matrix Composites; Strain Rate; Micromechanics; Mechanical Properties; Mathematical Models; Fiber Orientation; Failure; Deformation

20000019607 Helsinki Univ. of Technology, Electromagnetics Lab., Espoo, Finland

On the Surface Effect in Thin Molecular or Composite Layers

Simovski, C. R., Helsinki Univ. of Technology, Finland; Tretyakov, S. A., Helsinki Univ. of Technology, Finland; Sihvola, A. H., Helsinki Univ. of Technology, Finland; June 1999; ISSN 1456-632X; 20p; In English; Sponsored in part by Swedish Inst.

Report No.(s): PB2000-100823; Rept-299; ISBN 951-22-4591-4; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

The electromagnetic properties of thin dielectric or composite layers are considered. We study the case when the thickness d of a slab is so small that only a few particles forming the effective medium are located on the interval d. A novel approach to the quasistatic modeling of the local field acting on a particle is suggested. In this case the local ”permittivity” near the upper and lower surfaces of the slab differs from the bulk permittivity of the same material. This can influence the reflection and transmission properties of the slab. Even if the particles are isotropically polarizable or are randomly oriented in the slab volume, this this structure has anisotropic (uniaxial) electromagnetic properties.

NTIS

Electromagnetic Properties; Dielectrics; Composite Materials; Slabs

20000019615 California Inst. of Tech., W. M. Keck Lab. of Engineering Materials, Pasadena, CA USA

Synthesis and Characterization of Particulate Reinforced Zr57Nb5Al10Cu(15.4)Ni(12.6) Bulk Metallic Glass Composites

Choi-Yim, H., California Inst. of Tech., USA; Busch, R., California Inst. of Tech., USA; Koester, U., Dortmund Univ., Germany; Johnson, W. L., California Inst. of Tech., USA; Acta Materialia; 1999; ISSN 1359-6454; Volume 47, No. 8, pp. 2455-2462; In English

Contract(s)/Grant(s): DAAH04-95-1-0233; F4920-97-0323; DE-FG03-86ER-45242

Report No.(s): AD-A370026; ARO-34564.11-MS; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

The Zr57Nb5Al10Cu(15.4)Ni(12.6) bulk metallic glass forming liquid is reinforced with WC SiC, W, or Ta particles. Structure, microstructure and thermal stability of the composites art studied by X-ray diffraction, optical microscopy and differential scanning calorimetry. The metallic glass matrix remains amorphous after adding up to 20 vol.% of particles. The reactions at the interfaces between the matrix and the different reinforcing materials are investigated with scanning electron microscopy, transmission electron microscopy and electron microprobe. The mechanical properties of the composites am studied in compression and tension. The influence of the introduced particles on the thermal stability of the matrix as well as on the mechanical properties is discussed.

Author

Amorphous Materials; Metallic Glasses; Reinforcing Materials; Matrix Materials; Particulate Reinforced Composites

20000019628 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

Induction Heating of Carbon-Fiber Composites: Electrical Potential Distribution Model *Final Report, Dec. 1994-Mar. 1996*

Fink, Bruce K.; McCullough, Roy L.; Gillespie, John W., Jr.; Nov. 1999; 45p; In English

Report No.(s): AD-A370929; ARL-TR-2130; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Mechanisms of heat generation and distribution in carbon-fiber-based composites subjected to an alternating magnetic field are considered. A model that predicts the strength and distribution of these heat sources in the plane of the cross-ply laminate configurations has been developed and verified. In this analysis, the fibers in a cross-ply pair are treated as a grid of conductive loops in the plane. Each such conductive loop uses the alternating magnetic field to produce a rotational electromotive force that induces electric fields in the polymeric regions. Induced electromagnetic energy is converted into thermal energy through dielectric losses in polymeric regions between the carbon fibers in the adjacent orthogonal plies that the conductive loops comprise. Each possible conductive loop is accounted for, and the resulting superposition of potential differences at the nodes leads to the in-plane profile of the electric field in the polymeric regions. Data from AS4 graphite-reinforced polyetheretherketone (PEEK) laminate surface temperature measurements using liquid crystal sheets compare qualitatively with the theory.

DTIC

Fiber Composites; Laminates; Dielectrics; Carbon Fibers; Electric Fields; Induction Heating; Liquid Crystals; Temperature Measurement

20000020765 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Non-Polluting Composites Repair and Remanufacturing for Military Applications: An Environmental and Cost-Savings Analysis
Newton, Crystal H.; Fink, Bruce K.; McKnight, Steven H.; Gillespie, John W., Jr.; Palmese, Giuseppe R.; Sep. 1998; 62p; In English; Prepared in collaboration with the University of Delaware, Center for Composite Materials.
Report No.(s): AD-A371096; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Polymer-matrix composite material and structural adhesive repair and manufacturing have significant environmental cost. These costs are documented based on current and anticipated future Department of Defense use of these materials. This special report first establishes an environmental baseline by identifying the hazardous materials encountered during composite repair and manufacturing operations and presents conservative estimates of usage and waste production. The principal issues for reducing the environmental impact and its associated cost are: (1) reduction in hazardous waste by eliminating shelf-life limitations; (2) reduction in nitrogen oxides by replacing global heating of the part with localized heating; (3) reduction in volatile organic compound emissions by accelerated curing and containment; and (4) reduction in hazardous waste by minimizing production debris through processing step management. The effect of addressing these issues is evaluated from both environmental and cost perspectives based on the assumption that the necessary technology advances can be made.
DTIC
Environment Effects; Polymer Matrix Composites; Manufacturing; Adhesives; Costs; Defense Program; Hazardous Wastes

20000020768 Arizona Univ., Dept. of Materials Science and Engineering, Tucson, AZ USA
Smart Materials by Extrusion Solid Freeform Fabrication. Brief Annotations ***Final Report, Jan. 1995 - Jun. 1999***
Calvert, Paul; Nov. 02, 1999; 5p; In English
Contract(s)/Grant(s): DAAH04-95-1-0416
Report No.(s): AD-A371499; ARO-34377.6-MS; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

Extrusion freeform fabrication allows materials to be built layer by layer to form a solid. by combining different materials it is possible to attain new combinations of properties and to design the response of a material for the local stresses on a part. Most biological structures are built layer by layer and show excellent adaption of structure to function. This method has been used to form hydrogels and then mineralize them to very volume fractions of inorganic material. The resulting composites are tough, stiff and strong. The approach has also been used to make electrically stimulated muscle-like actuators of two types of hydrogel, crosslinked polyacrylic acid and crosslinked polyacrylamide. One layer of gel contracts in the applied field, the other layer acts as a passive, soft reservoir which takes up the extruded water without limiting contraction of the active layer. This system has been adapted to make an electrically-driven reversible gel ”jack”. When a field is applied the sample changes thickness by 10% in about 60 seconds and then returns to the original state when the field is reversed. This is close to what would be needed for a synthetic electrical muscle in that it provides a large, reversible linear expansion at constant volume.
DTIC
Smart Materials; Extruding; Fabrication

20000020936 XC Associates, Inc., Berlin, NY USA
High Thermal Conductivity Composite Structures ***Final Report, May - Nov. 1999***
Bootle, John; Oct. 20, 1999; 20p; In English
Contract(s)/Grant(s): N00167-99-C-0047
Report No.(s): AD-A371758; TR-1000-0282; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The work accomplished in this SBIR project demonstrated that the addition of boron nitride (BN) powder to a composite laminate significantly increases the through the thickness thermal conductivity (kz) of a composite laminate. The importance of this work is that the improved kz results in significantly lower operating temperatures for thermal applications such as composite thermal planes for advanced electronic applications and space based radiators. The advantage of this material compared to competing materials that it can be used to fabricate high strength, high thermal conductivity, relatively thin structures less than 0.050” thick. Typical graphite fiber reinforced composite thermal planes have an in-plane thermal conductivity (Kx & Ky) in the range 300-650 w/m/K, based on the fiber selection. But, the relatively low kz of a typical composite laminate significantly reduces the efficiency of the thermal plane due to the high impedance to getting heat in or out of the laminate. Finite element analysis of typical composite thermal planes shows that by increasing the kz from about 1 w/m/K for a typical laminate to about 4 w/m/K, as achieved in this project, results in temperature reductions in the order of 30%.
DTIC
Thermal Conductivity; Composite Structures

20000021039 Dayton Univ. Research Inst., Research Inst., OH USA
Intrinsically Survivable Structural Composite Materials ***Interim Report, 15 Sep. 1997 - 14 Sep. 1998***
Rice, B. P.; Dec. 1998; 18p; In English
Contract(s)/Grant(s): F33615-95-D-5029; AF Proj. 4347
Report No.(s): AD-A366801; UDR-TR-98-000148; AFRL-ML-WP-TR-1999-4016; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This program was initiated to develop baseline material properties to compare against properties of newly developed nanocomposites. An evaluation of the effects of strain rate and temperature on the in-plane shear properties of AS4/3501-6 and AS4/APC-2 was conducted. These tests indicate that the strain-to-failure and toughness of the AS4/3501-6 is highly strain rate dependent but the AS4/APC-2 is not. Budget cuts resulted in early termination of the program.
DTIC
Composite Materials; Construction Materials

25
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

20000015352 California Inst. of Tech., Pasadena, CA USA
Metal Mediated Two-Dimensional Protein Crystallization ***Final Report, 1 Sep. 1995 - 31 Aug. 1999***
Arnold, Farnces H.; Nov. 12, 1999; 6p; In English
Contract(s)/Grant(s): DAAH04-95-1-0613
Report No.(s): AD-A371468; ARO-34685.1-LS; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have developed a microfabricated system for sorting cells for ”directed evolution”. Our microfabricated fluorescence-activated cell sorter (FACS) can be used for the sorting of various biological entities , ranging from e. coli cells to single molecules of DNA. The actual sell-sorting is performed on a disposable ”micromashined ship” with a detection volume of approx. 250 femtoliter. Our intent is to construct a sell-sortet that is smaller in size, higher in sensitivity and lower in cost than the conventional electrostatic FACS apparatus. We hope to apply this technology to various chemical and biological studies, including molecular evolution of technologically-useful enzumes.
DTIC
Proteins; Crystallization; Protein Crystal Growth; Two Dimensional Models

20000017949 Bowling Green State Univ., Center for Photochemical Sciences, OH USA
Photocycloaddition and Ortho-Hydrogen Abstraction Reactions of Methyl Arylglyoxylates: Structure Dependent Reactivities
Hu, Shengkui, Bowling Green State Univ., USA; Neckers, Douglas C., Bowling Green State Univ., USA; Oct. 11, 1999; 11p; In English
Contract(s)/Grant(s): N00014-97-I-0834
Report No.(s): AD-A369536; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

In photocycloaddition reactions between methyl ary glyoxylates and certain 1,3-cyclodienes, the diastereochemical outcome of the photoproducts is shown to depend on the steric demand of the aryl group in the glyoxylate. Exclusive endo-aryl oxetanes were produced with bulky arylglyoxylates while no significant stereoselectivity was observed with glyoxylates containing less demanding aryl groups. This observation is rationalized by considering the stability of possible conformers of the intermediate 1,4-biradical at the instance of intersystem crossing. When these ortho-substituted phenylglyoxylates were irradiated in benzene, different reaction patterns were observed with different substituents on the aryl rings. The rates of ortho-hydrogen abstractions vary significantly among the individual compounds. Photoproducts thus resulting are dependent on the substrate structures.
Author
Methyl Compounds; Ortho Hydrogen; Reaction Kinetics; Association Reactions; Photochemical Reactions

20000019604 Helsinki Univ. of Technology, Lab. of Physical Chemistry, Espoo, Finland

The Theory of Photoelectrochemistry

Kinnunen, Petri, Helsinki Univ. of Technology, Finland; 1999; 32p; In English

Report No.(s): PB2000-100831; Rept-26; ISBN 951-22-4676-7; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

The purpose of this literature survey is to present different kinds of approaches to photoelectrochemistry in oxide film studies. The important terms concerning semiconductors are discussed and measurement results for nickel oxide films given in literature are presented.

Derived from text

Photoelectrochemistry; Oxide Films

20000019611 North Carolina Univ., Dept. of Chemistry, Chapel Hill, NC USA

Alkali Metal Alkoxide Clusters: Convenient Catalysts for the Synthesis of Methylphosphonates

Kissling, Rebecca M., North Carolina Univ., USA; Gagne, Michel R., North Carolina Univ., USA; Journal of Organic Chemistry; 1999; Volume 64, No. 5, pp. 1585-1590; In English

Contract(s)/Grant(s): DAAG55-98-1-0257

Report No.(s): AD-A369832; ARO-37552.3-CH; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

Alkali metal alkoxides are good catalysts (1-8 mol %) for promoting the interchange reaction between carbonyl and phosphorus esters. This reactivity leads to convenient methodologies for the synthesis of symmetric and unsymmetric alkyl-substituted methylphosphonates from dimethyl methylphosphonate (DMMP). Reactions rates are high with initial turnover frequencies (N) in excess of 1 x 10(exp 6)/h observed and with KO(t)Bu is greater than NaO(t)Bu is greater than LiO(t)Bu. The reactions were sensitive to steric effects in the product methylphosphonates with reaction rates paralleling the size of the transferring alkoxide (n-alkyl is greater than isoalkyl is greater than > tert-alkyl). For the test reaction DMMP + isopropyl acetate, substitution kinetics were consistent with a scenario wherein each methoxide is replaced sequentially, and the substitution rate for the second displacement is substantially slower than the First. Kinetic studies on the first substitution process were indicative of a concentration dependent rate law; a scenario most easily accounted for by a coupled transesterification wherein alkoxide reversibly and independently adds to phosphonate and ester.

Author

Alkali Metals; Alkoxides; Catalysts; Alkyl Compounds; Methyl Compounds

20000019613 Puerto Rico Univ., Dept. of Chemistry, San Juan, Puerto Rico

Adsorption and Decomposition of Ru3(CO)9(CH3CN)3 at Platinum Surfaces: An X-Ray Photoelectron Spectroscopy and Fourier Transform-Infrared Spectroscopy Study

Fachini, Estevao Rosim, Puerto Rico Univ., Puerto Rico; Cabrera, Carlos R., Puerto Rico Univ., Puerto Rico; Langmuir; 1999; Volume 15, No. 3, pp. 717-721; In English

Contract(s)/Grant(s): DE-FC02-91ER-75674; P-35825-CH-DPS; NSF OSR-94-52893

Report No.(s): AD-A369909; ARO-35825.3-CH-DPS; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

A CH3CN-modified triruthenium carbonyl cluster, Ru3(CO)9(CH3CN)3(I), has been absorbed on platinum oxide surfaces from dichloromethane solutions. The modified surface has been characterized by X-ray photoelectron spectroscopy (XPS) and polarized grazing angle Fourier transforms-infrared (FT-IR) microscopy. The proposed mechanism for the absorption of I involves the chemisorption of the metal cluster at the platinum surface by losing the acetonitrile ligand. The original cluster, Ru3(CO)12, could not be adsorbed under the same experimental conditions used for cluster I. The cluster-modified surface was treated with hydrogen for the reduction of the cluster to its metallic state on the Pt surface. This was done at different temperatures. The XPS results show the formation of a complex Ru-RuO2-RuO3/Pt surface.

Author

Adsorption; Decomposition; Ruthenium; Carbonyl Compounds; Metal Clusters; Chemisorption

20000019614 Alabama Univ., Dept. of Chemical and Materials Engineering, Huntsville, AL USA

A Laser Diagnostic Technique to Measure Chemical Delay Time in Hypergolic Combustion

Mays, L. O., Alabama Univ., USA; Farmer, M. J., Alabama Univ., USA; Smith, J. E., Jr., Alabama Univ., USA; Combustion Science and Technology; 1998; Volume 134, pp. 127-138; In English

Contract(s)/Grant(s): DAAH01-91-D-R002; DAAH04-94-G-0265

Report No.(s): AD-A370033; ARO-33155.8-EG-DPS; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

A new method to measure and examine ignition delays for hypergolic acid-organic reactants is described. Methods of previous investigations will be critically compared by mixing techniques, sensing devices, repeatability, and chemical

composition for the influence of then parameters on ignition delay measurements. The time delay for hypergolics to read from initial contact to the appearance of flame is classically termed the ignition delay. This technique as a result of its resolution, is the first to measure the chemical reaction time just prior to ignition. This new chemical performance measurement defines the time during which free radicals generated by the reaction should be analyzed by spectroscopic techniques. Unsymmetrical dimethylhydrazine, hydrazine, and furfuryl alcohol were individually reacted with various nitric acid mixtures, For the furfuryl alcohol-white fuming nitric acid system, this technique is the first to show that an initiation-propagation step is required for complete hypergolic combustion. This met also is the first to quantitatively measure the chemical performance of the hypergolic reactants, The technique clearly identifies the chemical delay time within the classic definition of the ignition delay time. The chemical delay tune permits direct comparison of chemical performance of hypergolic acid-organic reactions.
Author
Reaction Time; Chemical Reactions; Time Lag; Ignition; Chemical Composition; Combustion

20000019667 Idaho National Engineering Lab., Idaho Falls, ID USA
Direct Imaging of Anisotropic Material Properties using Photorefractive Laser Ultrasound
Telschow, K. L.; Schley, R. S.; Watson, S. M.; Deason, V. A.; Jun. 01, 1999; 7p; In English; 9th; 9th International Symposium on Nondestructive Characterization of Material, 28 Jun. - 2 Jul. 1999, Sydney, Australia
Report No.(s): DE00-008969; INEEL/CON-98-01179; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Anisotropic properties of materials can be determined by measuring the propagation of elastic waves in different directions. A laser imaging approach is presented that utilizes the adaptive property of photorefractive materials to produce a real-time measurement of the antisymmetric Lamb or flexural traveling wave mode displacement and phase. Continuous excitation is employed and the data is recorded and displayed in all directions simultaneously at video camera frame rates. Fourier transform of the data produces an image of the wave slowness in all planar directions. The results demonstrate imaging of microstructural isotropy and anisotropy and stress induced anisotropy in plates.
NTIS
Imaging Techniques; Anisotropy; Ultrasonic Radiation; Lamb Waves; Elastic Waves; Wave Propagation; Traveling Waves

20000019679 Environmental Protection Agency, Office of Water, Washington, DC USA
Methods, Occurrence and Monitoring Document for Radon from Drinking Water. Public Comment Draft
Nov. 1999; 232p
Report No.(s): PB2000-102455; EPA/815/D-99/003; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

These Methods, Occurrence, and Monitoring (MOM) Document has been developed by EPA in support of the rulemaking process for radon in drinking water. The Agency is proposing a Maximum Contaminant Level Goal (MCLG) and National Primary Drinking Water Regulations (NPDWR) for radon-222 in public water supplies. The purposes of this document are: identification of available analytical methods for monitoring radon in groundwater sources and in drinking water; discussion of the patterns of occurrence of radon in groundwater and drinking water; and explanation of alternative monitoring schemes for assuring compliance with the proposed rule.
NTIS
Radon Isotopes; Potable Water; Ground Water

20000019680 National Inst. of Standards and Technology, (BFRL), Gaithersburg, MD USA
Comparison of CFAST Predictions to USCG Real-Scale Fire Tests
Reneke, P. A.; Peatross, M. J.; Jones, W. W.; Beyler, C. L.; Richards, R.; Jan. 2000; 24p; In English
Report No.(s): PB2000-102498; NISTIR-6446; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The zone model CFAST was used to make predictions of single room pre-flashover fire tests conducted in a steel enclosure. These results were then compared with previously published measurements obtained in fire tests. Tests included diesel pool fires, polyurethane slab fires, and wood crib fires. Half of these tests used natural ventilation while the remaining tests used forced ventilation. With the exception of heat release rates, all CFAST inputs were selected without knowledge of the experimental results. Key variables compared include the upper layer temperature, the hot layer interface location, and ceiling temperatures. Overall, predictions made by CFAST were in good agreement with the data. There was a general tendency to overpredict both the hot gas layer temperature and the boundary surface temperature which may be due to underprediction of boundary heat losses. Experimental results showed that heat release rates varied with ventilation configurations by as much as a factor of 3. This

observation indicates that the wide practice of using free burn heat release rate data in compartment fire predictions can result in overprediction of compartment fire conditions.
NTIS
Ventilation; Fires; Flame Propagation; Burning Rate

20000020687 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA
Portable Real Time Neutron Spectrometry
Maurer, R. H., Johns Hopkins Univ., USA; Roth, D. R., Johns Hopkins Univ., USA; Fainchtein, R., Johns Hopkins Univ., USA; Goldsten, J. O., Johns Hopkins Univ., USA; Kinnison, J. D., Johns Hopkins Univ., USA; Thompson, A. K., National Inst. of Standards and Technology, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 500-502; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

High energy charged particles of extra-galactic, galactic and solar origin collide with spacecraft structures in Earth orbit outside the atmosphere and in interplanetary travel beyond the Earth's magnetosphere. These primaries create a number of secondary particles inside the structures that can produce a significant ionizing radiation environment. This radiation is a threat to long term inhabitants or travelers for space missions and produces an increased risk of cancer and DNA damage. The primary high energy cosmic rays and trapped protons collide with common spacecraft materials such as aluminum and silicon and create secondary particles inside structures that are mostly protons and neutrons. Charged protons and heavy ions are readily detected and instruments are already in existence with new versions in development for this task. Neutrons are electrically neutral and therefore much more difficult to detect and measure. These neutrons have been hypothesized to contribute 30-35% of the dose inside space structures and cannot be ignored. A recent measurement of low energy neutrons on a shuttle flight and suggest a contribution of 36% inside a shuttle locker. Currently there is no compact, portable and real-time neutron detector instrumentation available for use inside spacecraft or on planetary surfaces where astronauts will live and work.
Author
Spectrometers; Risk; Real Time Operation; Particle Energy; Neutron Counters; Ionizing Radiation; Heavy Ions; Dosage; Damage

20000020742 Army Construction Engineering Research Lab., Champaign, IL USA
Electrochemical Reduction of Nitro-Aromatic Compounds Product Studies and Mathematical Modeling ***Final Report***
Meenakshisundaram, Devakumaran; Mehta, Manish; Pehkonen, Simo; Maloney, Stephen W.; Oct. 1999; 72p; In English
Report No.(s): AD-A371059; CERL-TR-99/85; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Nitro-aromatics: 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (DNT) and hexa-hydro-1,3,5-trinitro-triazine (RDX) are the major constituents of wastewaters discharged from propellant and explosive manufacturing units and munitions load, assembly, and pack Operations. More than 1,200 current and former U.S. Department of Defense and U.S. Department of Energy facilities have problems with explosive contamination. The objective of this project was to study the electrochemical degradation of nitro-aromatic compounds under various conditions to enable the formulation of a mathematical model and to design a plug flow reactor for the same. The transformation of DNT and TNT to their corresponding reduced by-products has been shown to occur through purely abiotic mechanisms induced by electric current.
DTIC
Mathematical Models; Electrochemistry; Aromatic Compounds; Nitro Compounds; Propellants; RDX; Trinitrotoluene

20000020771 Colorado Univ., Dept. of Physics, Boulder, CO USA
Biomolecular Mask Formation Using UV Patterened Sam Films ***Final Report, Feb. 1996 - 31 Jan. 1999***
Douglas, Kenneth; Apr. 30, 1999; 5p; In English
Contract(s)/Grant(s): F49620-96-1-0023
Report No.(s): AD-A371609; AFRL-SR-BL-TR-99-0295; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

The research focus has been on the challenging issues involved in achieving, two-dimensional recrystallization of protein (S-layer) monomers in large (-several hundred micron) single crystal areas. to acquire facility with the recrystallization process we first explored the experimental conditions which influence protein crystallization e.g., protein concentration. temperature, pH, ionic strength concentration of various mono- and divalent cations, etc. We attempted crystallization experiments in aqueous suspension or at the air/water interface before trying to reassemble protein monomers directly on a patterned surface. We were able to obtain large (- 1 micro x 2 micro), well-ordered, recrystallized protein patches following dialysis. As with the native protein crystal, the recrystallized S-layers showed a square lattice with lattice parameter of 13 nm. We established a reproducible protocol for preparing a solution of S-layer monomers for a recrystallization experiment. We used both thin film carbon substrates on transmission electron microscope (TEM) grids as well as bulk silicon substrates for a variety of diagnostic recrystallization

experiments. Protocols for these experiments were established and numerous experiments carried out, including; grid modification: float, touch, and time; gluteraldehyde crosslinking of S-layer crystal; and floatation of the formvar directly on the recrystallization solution. We attempted to extrapolate from our work with TEM grids to recrystallization experiments directly on Si wafers.
DTIC
Masks; Recrystallization

20000020833 General Electric Co., Combustion Center of Excellence, Cincinnati, OH USA
Empirical and Anchored Methodologies for Controlling Combustion Dynamics
Pandalai, Raghavan P., General Electric Co., USA; Hsiao, George C., General Electric Co., USA; Mongia, Hukam C., General Electric Co., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 5-1 - 5-14; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper describes the empirical and anchored methodologies developed at General Electric Aircraft Engines (GEAE) to control combustion dynamics in aircraft and aero-derivative industrial turbine engine combustion systems. Combustion instability problems in aircraft and more recently in aero-derivative industrial engine combustors have been a serious problem during development, and in some production engines. The conventional approach to this problem has been based largely on empirical correlations and design experience. The advent of low emissions combustors for aircraft and industrial applications which incorporate several innovative technologies have put additional pressures to look at this problem from a more fundamental viewpoint so as to identify a dynamics 'fix' quickly based on root cause, and minimum testing to demonstrate the fix. To achieve this goal, a physics based combustion dynamics model is developed and described in this paper. The acoustic abatement technology that has made an optimum use of both the passive and active control technique (hybrid control system) employed in GEAE's product lines consistent with customers' needs has also been integrated into this model. The formulation of the dynamics model is based on the exact solution of the acoustic wave equation and is capable of incorporating several features unique to gas turbine combustors. The current approach is built on an acoustic based framework and the total combustion system from compressor exit to first stage turbine nozzle including fuel delivery system, fuel premixer and acoustic damping devices are incorporated into this model because of their impacts on overall dynamics. Engine test data obtained during the development phase of GEAE's ultra low emission industrial engine combustor development program was used to demonstrate the feasibility of the model and the anchored approach. The predicted trends not only agreed very well with test data, but also demonstrated the capability of the model to distinguish between acoustically active and inactive regimes of operation.
Author
Gas Turbine Engines; Combustion Stability; Aircraft Engines; Combustion Physics; Engine Design; Mathematical Models

20000020834 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
NO(x) Reduction by Lean Premixed Prevaporized Combustion
Ripplinger, T., Motoren- und Turbinen-Union G.m.b.H., Germany; Zarzalis, N., Motoren- und Turbinen-Union G.m.b.H., Germany; Meikis, G., Motoren- und Turbinen-Union G.m.b.H., Germany; Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Brandt, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 7-1 - 7-12; In English; See also 20000020829
Contract(s)/Grant(s): BMBF-0326782D/215; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A low emission working by lean combustion with premixing and prevaporizing of liquid fuel is presented for aero jet engine and power generation applications. A model rectangular combustor was designed and manufactured as a portion from a full annular combustor and investigated in medium- and high-pressure tests at burner inlet temperatures up to 820 K and at operating pressures up to 20 bar. The design of the combustor was supported by 3D CFD calculations, which were conducted in order to optimise the flow field within the combustor, especially with a view to creating a sufficient recirculation zone for flame stabilization. In addition to the combustor tests, investigations were carried out with the two phase flow within the premixer by means of optical measuring techniques at the German Aerospace Research Establishment (DLR Cologne). With the present design of the premixing duct and the airblast atomizer the liquid fuel can almost be completely evaporated within a premixing length of 150 mm, corresponding to a residence time of the fuel/air mixture in the premixer of 1.25 - 1.5 ms. The model combustor was operated at burner inlet temperatures of up to 820 K and at operating pressures of up to 20 bar with no autoignition of the fuel/air mixture within the premixing duct or flash back of the flame into the premixer occurring. The combustor combines very low NO(x) emissions (up to 85 % less NO(x) than a low NO(x) diffusion combustor) with high combustion efficiencies (above 99 % and a

sufficient stability range (Phi(min.,Primary) = 0.5). Therefore, the present LPP concept provides a promising configuration for an ultra low NO(x) combustor, both for aero engine and power generation applications.
Author
Nitrogen Oxides; Aircraft Engines; Combustion; Combustion Products; Emission; Prevaporization; Premixing; Two Phase Flow

20000020835 South Carolina Energy Research and Development Center, Advanced Gas Turbine Systems Research, Clemson, SC USA
Status of Catalytic Combustion R and D for the Department of Energy Advanced Turbine Systems Program
Fant, D., South Carolina Energy Research and Development Center, USA; Jackson, G., Maryland Univ., USA; Karim, H., Precision Combustion, Inc., USA; Newburry, D., Siemens Westinghouse Power Corp., USA; Dutta, P., Solar Turbines, USA; Smith, K., Solar Turbines, USA; Smith, D., Rolls-Royce Allison, USA; Dibble, R., California Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 8-1 - 8-15; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper discusses paper discusses some of the advanced concepts and fundamental R&D needs associated with implementing catalytic combustion systems to achieve ultra-low NO(x) emissions in the next generation of land-based gas turbine engines. In particular, the paper presents the development status and current design challenges being addressed by Siemens Westinghouse Power Corporation, Solar Turbines, and Rolls-Royce Allison, as part of the U.S. Department of Energy's (DOE) Advanced Turbine Systems (ATS) program. In addition, issues on catalytic combustion economics, durability and operability will be highlighted.
Author
Gas Turbine Engines; Catalysis; Combustion; Nitrogen Oxides; Emission

20000020839 Universidad Politecnica de Madrid, Madrid, Spain
Reduced Kinetic Mechanisms for Modelling LPP Combustion in Gas Turbines
Linan, A., Universidad Politecnica de Madrid, Spain; Bollig, M., Universidad Politecnica de Madrid, Spain; Sanchez, A. L., Universidad Carlos 3 de Madrid, Spain; Lazaro, B., Sener S.A., Spain; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 12-1 - 12-10; In English; See also 20000020829
Contract(s)/Grant(s): CEC-BRPR-CT95-0122; CICYT-C95013002; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Lean premixed methane-air flames are investigated in an effort to facilitate the numerical description of CO and NO emission in LPP (lean premixed prevaporized) combustion systems. Starting with a detailed chemistry description that includes 195 elementary steps, sensitivity procedures and steady-state approximations are introduced to obtain two different four-step reduced mechanisms, which employ either H or OH as the intermediate representing the radial-pool evolution. The resulting reduced mechanisms are especially well suited to describe high-pressure, lean premixed combustion. Based on the resulting flame structures, and following previous analyses, the mechanism is further simplified to give a two-step description, in which fuel is consumed and CO is produced according to the fast overall step CH4 + (3/2)O2 yields CO + 2H2O, while CO is slowly oxidized according to the overall step CO + (1/2)O2 yields CO2. Because of its associated fast rate, fuel consumption takes place in thin layers, while CO oxidation occurs downstream in a distributed manner, in a region where CO is the only intermediate not in steady state. In this two-step description, the rate of fuel consumption is assigned a heuristic Arrhenius dependence that adequately reproduces laminar burning velocities, whereas the rate of CO oxidation is extracted from a reduced chemistry analysis. Preliminary results corresponding to one-dimensional unstrained flames indicate that the formulation reproduces well flame structures, including profiles of CO, temperature and radicals. The accuracy of the resulting profiles suggests that the proposed formulation can also be used to calculate NO emissions by appending the appropriate chemistry. Although methane is employed in the present study as a model fuel, the universal structure of the resulting CO oxidation region, independent of the fuel considered, enables the proposed formulation to be readily extended to other hydrocarbons.
Author
Gas Turbines; Carbon Monoxide; Nitrogen Oxides; Premixed Flames; Exhaust Emission; Combustion; Methane; Premixing

20000020841 Centre National de la Recherche Scientifique, Lab. de Combustion et Systemes Reactifs, Orleans, France
Kerosene Combustion Modelling Using Detailed and Reduced Chemical Kinetic Mechanisms
Cathonnet, M., Centre National de la Recherche Scientifique, France; Voisin, D., Centre National de la Recherche Scientifique, France; Etsouli, A., Centre National de la Recherche Scientifique, France; Sferdean, C., Centre National de la Recherche Scientifique, France; Reuillon, M., Centre National de la Recherche Scientifique, France; Boettner, J. C., Centre National de la Recherche Scientifique, France; Dagaut, P., Centre National de la Recherche Scientifique, France; Gas Turbine Engine

Combustion, Emissions and Alternative Fuels; June 1999, pp. 14-1 - 14-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

The growing cost of experimental tests in aircraft combustors and the efforts to reduce development time, lead combustor designers to develop computer programs in order to predict the performances of the combustors. The contribution made by these calculation methods has become all the more important, given that the increase in severity in military engine cycle and requirements for reducing pollution in civil aircrafts needed different types of combustor structure to be designed. In many of these combustion models, chemical kinetics is reduced to a single-step empirical expression or to global multistep schemes. However, a better knowledge of the chemistry of combustion is essential for the quality of the prediction of many important phenomena like ignition delays, flame speed, blow-out, engine efficiency and pollutant emissions. Therefore, several studies in the field of chemical kinetics have been devoted to the conception of reaction mechanisms with growing complexity for the representation of kerosene oxidation. In a previous study on kerosene oxidation in a jet-stirred reactor at atmospheric pressure, a quasi-global model was proposed to reproduce the concentration profiles of the major chemical species. Unfortunately, quasi-global mechanisms cannot be used in the whole range of operating conditions of a combustion chamber. In fact, the validity domain of chemical kinetic schemes in terms of temperature, pressure and equivalence ratio has to be large enough in order to include the wide range of operating conditions of modern combustors. This is particularly true for the prediction of carbon monoxide and unburned hydrocarbons which are intermediate products of combustion mainly at low ratings, or for the prediction of nitrogen oxides which are mostly produced at high temperature and pressure. Because of the superiority of detailed chemical kinetic mechanisms to predict combustion chemistry features, we have begun to develop detailed mechanisms for the oxidation of higher hydrocarbons in a wide range of temperatures. However, very large mechanisms cannot be introduced into complex multi-dimensional fluid dynamics codes for the modelling of the combustion of practical fuels. For this reason, we have also used reduction methods for the simplification of large mechanisms in order to keep the essential features of the chemistry in realistic combustor configurations. Previous studies in jet-stirred and in premixed flames have shown similar combustion behaviours between kerosene and n-decane, concerning the nature of the products and the reactivity. For this reason, a detailed reaction mechanism for the oxidation of n-decane has been used to describe the combustion of kerosene in a jet-stirred reactor up to 40 atm, and a good prediction of the experimental concentration profiles of the major species has been obtained. This mechanism has been recently updated, and a general improvement of the predictions was obtained, especially for unburned hydrocarbons. In addition, a reduced mechanism was developed. However, in the conditions of our experiments, several aromatics have been found in significant amounts among the products of kerosene oxidation, where the oxidation of n-decane yields much less aromatics. This is due to the presence of mono-aromatics in kerosene, these compounds being the main source of benzene, toluene and xylene formed in kerosene combustion. Naphtenes are another class of compounds constituting kerosene. to take into account the presence of these different families in kerosene, we have added to the mechanism of n-decane oxidation, the detailed mechanisms of the oxidation of toluene and cyclohexane.
Author

Reaction Kinetics; Combustion Chambers; Computer Programs; Combustion Chemistry; Exhaust Emission; Exhaust Gases; Hydrocarbons; Oxidation

20000020842 Instituto Superior Tecnico, Mechanical Engineering Dept., Lisbon, Portugal

Modelling of a Lean Premixed Combustor

Coelho, P. J., Instituto Superior Tecnico, Portugal; Salvada, P., Portuguese Air Force Academy, Portugal; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 15-1 - 15-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A mathematical model of a fuel lean premixed axisymmetric combustor is presented and applied to an experimental facility. The combustor is constituted by a pre-chamber where propane is injected and mixed with the oxidant, and the combustion chamber where most of the reactions take place. The mathematical model is based on the numerical solution of the equations governing conservation of mass, momentum and energy, and transport equations for scalar quantities. The k-epsilon model, the eddy break-up or the eddy dissipation models, and the discrete ordinates model are used to simulate turbulence, combustion and radiation, respectively. The results are compared with experimental data. The grid size and the discretization scheme are shown to have a significant influence on the results, demonstrating the need for error estimation in practical engineering computations. The influence of the constants of the combustion model and the role of the radiation model are examined. The influence of the equivalence ratio and the inlet air temperature are also investigated.
Author

Mathematical Models; Combustion Chambers; Combustion Physics; Continuity Equation; Energy Transfer; Premixing; Engine Parts; Engine Design

20000020844 Office National d'Etudes et de Recherches Aerospatiales, Dept. Mesures Physiques, Palaiseau, France

Optical Diagnostics Applied to a Jet Diffusion Flame

Grisch, F., Office National d'Etudes et de Recherches Aerospatiales, France; Attal-Tretout, B., Office National d'Etudes et de Recherches Aerospatiales, France; Bouchardy, P., Office National d'Etudes et de Recherches Aerospatiales, France; Katta, V. R., Innovative Scientific Solutions, Inc., USA; Roquemore, W. M., Air Force Research Lab., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 17-1 - 17-9; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

An experimental study was conducted on low speed hydrogen-air buoyant diffusion flames to investigate the vortex-flame interaction and the effect of the Lewis number on the flame structure. Simultaneous single shot measurements of temperature, pollutant nitric oxide (NO) and atomic oxygen (O) have been obtained using a combination of Coherent anti-Stokes Raman spectroscopy, laser-induced fluorescence and degenerate four-wave mixing. Temperature and molar fraction of NO and O are presented in two-dimensional maps and O are compared with theoretical predictions. It was found that temperature and NO concentration increase - with later being more significantly - in the compressed region of the flame whereas high concentration of oxygen atoms is located in the stretched region of the flame. Good agreement was found between the simulated and measured data.

Author

Diffusion Flames; Jet Flow; Hydrogen; Vortices; Flame Propagation; Lewis Numbers; Chemical Reactions; Optical Measurement

20000020845 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany

Experimental Investigation of an Axially Staged Combustor Sector with Optical Diagnostics at Realistic Operating Conditions

Hassa, C., Deutsches Zentrum fuer Luft- und Raumfahrt e.V., Germany; Carl, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Frodermann, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Behrendt, T., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Heinze, J., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Roehle, I., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Brehm, N., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Schilling, T., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Doerr, T., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 18-1 - 18-11; In English; See also 20000020829

Contract(s)/Grant(s): BMBF-20T9403A; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A rectangular sector of an axially staged combustor built by BMW-RR was investigated with optical diagnostics in a newly built experimental facility at DLR Cologne. The goal of the investigation was to acquire data on the combusting flow field of a practical combustor at realistic operating conditions to aid the design and validate results achieved with computational fluid dynamics (CFD). The rig is capable of operating at pressures up to 20 bar, preheat temperatures of 850K and air mass flows of 10 kg/s The combustor is optically accessible through the side windows and the combustor liners, which allows the use of planar imaging techniques. The measurement techniques applied so far are Doppler Global Velocimetry (DGV) for the isothermal flow, Laser Doppler Anemometry (LDA) for the gas velocity of the combusting flow, Phase Doppler Anemometry (PDA) for size and velocity of fuel droplets and Mie scattering of Kerosene for the imaging of the liquid fuel concentration. The reaction zone was investigated with measurements of the spontaneous OH emission. The paper reports results and experiences from those measurements at 1 and 6 bar. Application of CARS and OH-LIF for the in situ measurement of temperature and the extension of the application to 20 bar are planned for the immediate future.

Author

Combustion Chambers; Combustible Flow; In Situ Measurement; Computational Fluid Dynamics; Optical Measurement; Liquid Fuels

20000020849 National Aerospace Lab., Instrumentation Dept., Amsterdam, Netherlands

In-flight Spectroscopic Aircraft Emission Measurements

Jentink, H. W., National Aerospace Lab., Netherlands; vanVeen, J. J. F., Netherlands Organization for Applied Scientific Research TNO, Netherlands; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 22-1 - 22-4; In English; See also 20000020829; Copyright Waived; Avail: CASI; A01, Hardcopy; A06, Microfiche

Aircraft emit their exhaust gases for the larger part during cruise conditions. The knowledge about the emissions in these conditions is limited because adequate in situ measurement methods are not available. In this presentation the complications

encountered measuring exhaust gases in flight are addressed. The potential of spectroscopic measurement methods for this application is discussed. Experimental data gathered on ground are used to support the argumentation.
Author
Exhaust Gases; In Situ Measurement; Onboard Equipment; Cruising Flight; Gas Spectroscopy

20000020850 Defence Evaluation Research Agency, Propulsion Dept., Farnborough, UK
The Design and Evaluation of A Piloted, Lean Burn, Premixed, Prevaporised Combustor
Wedlock, M. I., Defence Evaluation Research Agency, UK; Tilston, J. R., Defence Evaluation Research Agency, UK; Seoud, R. E., Defence Evaluation Research Agency, UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 23-1 - 23-12; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A piloted, lean burn, premixed, prevaporised combustor was designed to significantly reduce NOx levels. The combustor performance was evaluated over a range of conditions typical of a future large subsonic turbofan. The results showed NOx reductions in the range of 70-80%. The work was carried out as part of the CEC BRITE EURAM LOWNOX II programme.
Author
Combustion Chambers; Nitrogen Oxides; Exhaust Emission; Premixing; Turbofans; Combustion; Environment Effects

20000020851 California Univ., Combustion Lab., Irvine, CA USA
Advance Fuel Injection Strategies for High Performance Gas Turbine Engines
Samuelsen, Scott, California Univ., USA; McDonell, Vince, California Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 24-1 - 24-14; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Advanced gas turbine combustion systems will demand fuel injection strategies that are efficient in the rapid mixing of fuel and air, sophisticated in the ability to control the spatial distribution of the fuel, and both sufficiently flexible and intelligent to accommodate change over the duty cycle of the engine. The paper reports performance of a candidate injector and strategies, through mechanistic studies with advanced diagnostics, to optimize the system.
Author
Fuel Injection; Fuel Combustion; Gas Turbine Engines; Pollution Control; Injectors

20000020853 BMW Rolls-Royce AeroEngines G.m.b.H., Dahlewitz, Germany
NOx Reduction in a Fuel Staged Combustor by Optimisation of the Mixing Process and the Residence Time
Brehm, N., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Schilling, T., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Mack, A., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Kappler, G., BMW Rolls-Royce AeroEngines G.m.b.H., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 27-1 - 27-13; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The paper deals with research work for NOx reduction carried out on an axially staged combustor. The combustor is operated with airblast atomizers and the combustion process is controlled by turbulent diffusion, like today's single annular combustors. Therefore the NOx formation is mainly defined by the time the combustion products spend at high temperatures. The objective of the work presented here was the reduction of NOx by the optimisation of the mixing process, combined with a reduction of the overall residence time. Three concepts were first investigated by computational fluid dynamics (CFD). The special emphasis was to distinguish differences in the mixing process, which indicate an improvement for NOx reduction. Based on this, the different configurations were tested in a high pressure sector rig under realistic engine conditions. A systematic NOx reduction was achieved by optimisation of the combustor geometry, leading to a more enforced, fast combustion process.
Author
Fuel Combustion; Combustion Chambers; Mixing; Pollution Control; Nitrogen Oxides

20000020855 Naples II Univ., Dept. of Aerospace Engineering, Naples, Italy
Ignition Diagrams and Bifurcation Maps
DiMaio, F. P., Naples II Univ., Italy; Barnieri, G., Consiglio Nazionale delle Ricerche, Italy; Lignola, P. G., Naples II Univ., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 31-1 - 31-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

In this work a method is presented for the analysis of models of combustion processes. The method, based on the theory of bifurcation and on that of continuation, permits the calculation of ignition diagrams for combustion systems reacting in zero

dimensional combustion devices. The method is applied to combustion of hydrogen and the results are encouraging. Selected residence times have been investigated. A rich variety of dynamic behaviours has been detected, as experimentally observed.
Author
Combustion; Branching (Mathematics); Combustion Physics; Ignition; Mathematical Models

20000020857 Rolls-Royce Allison, Indianapolis, IN USA
Fuel/Air Preparation in the Design of Low Emissions Gas Turbine Combustion Systems
Razdan, Mohan K., Rolls-Royce Allison, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 34-1 - 34-11; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper discusses issues related to practical fuel injection methods, and the key factors affecting the fuel/air mixing process in low emission gas turbine combustors. The mixing of fuel and air has to be accomplished in the shortest possible residence time both for current retroflt applications as well as for future high performance engines that operate at substantially higher inlet temperatures and pressures, where flashback and autoignition are serious concerns. The choice of a fuel injection method is strongly influenced not only by the selected geometry and size of a fuel/air preparation module but also by its interaction with the module air flow. Combining pressure swirl and prefilming airblast atomization concepts in a single hybrid design presents an attractive approach for achieving satisfactory atomization over a wide operating range of the combustor. Internally mixed atomization concepts show beneficial effects on fuel atomization. A fuel concentration profile tailored to the local velocity profile at the mixing module exit minimizes the flashback propensity. Autoignition concerns will limit the application of fully prevaporized lean premixed low emission approach to operating pressures up to 40 to 50 atmospheres.
Author
Air Flow; Spontaneous Combustion; Ignition; Flashback; Engine Design; Fuel Injection; Combustion Chambers; Gas Turbine Engines

20000020858 Imperial Coll. of Science Technology and Medicine, Thermofluids Section, London, UK
Experiments in a Small Gas-Turbine Combustor with Gas and Liquid Fuels
Heyes, A. L., Imperial Coll. of Science Technology and Medicine, UK; Jelercic, D., Imperial Coll. of Science Technology and Medicine, UK; Whitelaw, J. H., Imperial Coll. of Science Technology and Medicine, UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 35-1 - 35-17; In English; See also 20000020829; Original contains color illustrations
Contract(s)/Grant(s): EPSRC-GR/K-60985; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Measurements of velocity, temperature, emissions and droplet diameters are reported for combustion of kerosene in a sector of a gas-turbine combustor at atmospheric pressure and air-fuel ratios and preheat temperatures corresponding to cruise and take-off conditions. The results allow comparison of flows with fuelling devices which include gas jets, a T-vaporiser and two arrangements of fan sprays, and show the extent to which droplet diameters and velocities were affected by the rate of fuel flow and by the air preheat in the main vortex of the primary zone. A single fan spray led to a central core of combustion with cold flow on either side so that the pattern factor had no practical value and subsequent experiments made use of two sprays. The droplet numbers density fell rapidly with distance from the injectors and with increasing air-fuel ratio and preheat temperature, and the arithmetic and Sauter mean diameters tended to decrease as droplets evaporated and burned. The exit-plane profiles of temperature were more uniform with the higher preheat temperature and lower air-fuel ratio which resulted in a combustion efficiency of 98.3% The lower preheat temperature led to a three-fold increase in concentrations of unburned hydrocarbon and efficiency of 91.6%. Emissions were similar with the fan spray and the vaporiser arrangements, with NOx concentrations larger by 10% in the rich flows and smaller by 25% with the higher air-fuel ratio and lower preheat temperature.
Author
Combustion Chambers; Gas Turbine Engines; Engine Design; Propulsion System Performance; Fuel Combustion; Fuel Flow

20000020859 Pennsylvania State Univ., Dept. of Mechanical Engineering, University Park, PA USA
AGARD Workshops on Active Combustion Control for Propulsion Systems
Yang, Vigor, Pennsylvania State Univ., USA; Schadow, Klaus C., Naval Air Warfare Center, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 36-1 - 36-21; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This report summarizes the findings and conclusions of two A(iARD workshops on ”Active Combustion Control for Propulsion Systems” that were held during May 6-9. 1996, in Athens. Greece and during Oct. 16-18, 1997 in Brussels, Belgium respectively. The workshops. Organized in response to increased interest in application of’ active control in combustion systems, were attended by representatives from industry, government and universities in Europe and the USA. The objectives of the

workshops were to: (1) define the requirements of future combustors and combustion processes, (2) determine the status of active combustion control (ACC) systems, (3) assess the potential of ACC to meet goals of the future combustors performance, and (4) determine near- and longterm ACC research and development needs. A special concern of the workshops was the confirmation of international collaborations between organizations working in this field.
Author
Active Control; Combustion Chambers; Combustion Control; Engine Design

20000020860 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA
Combustion Instabilities in Low NOx Gas Turbines and Their Active Control
Zinn, Ben T., Georgia Inst. of Tech., USA; Lieuwen, Tim, Georgia Inst. of Tech., USA; Neumeier, Yedidia, Georgia Inst. of Tech., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 37-1 - 37-12; In English; See also 20000020829; Sponsored in part by AGTSR; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper presents an investigation of the mechanisms and control of combustion instabilities in low NOx gas turbines (LNGT) that burn fuel in a lean, premixed (LP) mode of combustion. Physical considerations show that these instabilities may be caused by interactions of combustor pressure oscillations with the reactants supply rates, producing equivalence ratio (0) perturbations in the inlet duct. These perturbations are convected by the mean flow to the combustor where they produce large amplitude heat release oscillations that drive combustor pressure oscillations. The regions of instability can be approximately described in terms of a ratio of the reactants' convective time from the fuel injector to the combustor and the period of the oscillations (with some modifications that account for the structure of the combustion region). Significantly, these predictions are in good agreement with available experimental data, strongly suggesting that the proposed mechanism properly accounts for the essential physics of the problem. The predictions of this study indicate that passive control strategies may not, in general, provide a viable means for controlling these instabilities, due to the multiple number of modes that may be excited by the combustion process. The paper closes with a discussion of a recently developed, observer based, active control system and its control of combustion instabilities in a small scale Georgia Tech combustor and a sub scale Westinghouse gas turbine are presented. These results demonstrate that active control is a promising means for controlling combustion instabilities.
Author
Active Control; Combustion; Combustion Stability; Combustion Chambers; Nitrogen Oxides; Reaction Kinetics; Premixing; Gas Turbines

20000020861 United Technologies Research Center, East Hartford, CT USA
Active Control of Combustion Instability in a Liquid-Fueled, Low-NOx Combustor
Cohen, Jeffrey M., United Technologies Research Center, USA; Rey, Nancy M., United Technologies Research Center, USA; Jacobson, Clas A., United Technologies Research Center, USA; Anderson, Torger J., United Technologies Research Center, USA; Rosfjord, Thomas J., United Technologies Research Center, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 38-1 - 38-10; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

A practical active control system for the mitigation of combustion instability has been designed and demonstrated in a lean, premixed, single-nozzle combustor at realistic engine operating conditions. A full-scale engine fuel nozzle was modified to incorporate a simple fuel flow actuator. Results indicate that the system was capable of reducing pressure fluctuations by 82% (15 dB or 5.6X) while maintaining or reducing NOx and CO emissions levels.
Author
Active Control; Combustion Stability; Combustion Chambers; Premixing; Fuel Flow; Environment Effects; Fuel Injection

20000020863 Siemens A.G., Muelheim-Ruhr, Germany
Application of Active Combustion Control to Siemens Heavy Duty Gas Turbines
Hoffmann, S., Siemens A.G., Germany; Weber, G., Siemens A.G., Germany; Judith, H., Siemens A.G., Germany; Hermann, J., Ingenieurbuero fuer Thermoakustik G.m.b.H., Germany; Orthmann, A., Ingenieurbuero fuer Thermoakustik G.m.b.H., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 40-1 - 40-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Modern gas turbines are usually featuring lean premixed combustion in order to keep the emissions at an acceptable level. Ever increasing reaction densities, however, result in an increased tendency to exhibit dynamic flame instabilities. Active Instability Control (AIC) is a very powerful and flexible tool for the suppression of these instabilities. Due to the high fuel mass flow and high system pressures, the application of AIC to heavy duty gas turbines, however, is a difficult task. This paper reports on several applications of an AIC system to the Siemens Model V84.3A and V94.3A heavy duty gas turbines featuring annular

combustion chambers. Depending on the burner configuration used, the AIC successfully solved four different tasks: Damping of combustion oscillations by up to 17 dB (86%); Complete suppression of combustion oscillations at intermediate load levels and during switch over processes; Suppression of combustion oscillations at low pilot gas mass flow during lean premixed operation, allowing for a substantial reduction of the NOx emissions; and Suppression of combustion oscillations at base load level, allowing for a 5%-point load increase. Several tests showed the long-term reliability of the hardware components and the failure tolerance of the AIC system.
Author
Active Control; Combustion Chambers; Combustion Stability; Gas Turbines; Combustion; Premixing; Emission

20000020864 Pennsylvania State Univ., University Park, PA USA
Optimization of Active Control Systems for Suppressing Combustion Instability
Lee, Jong Guen, Pennsylvania State Univ., USA; Hong, Boe-Shong, Pennsylvania State Univ., USA; Kim, Kwanwoo, Pennsylvania State Univ., USA; Yang, Vigor, Pennsylvania State Univ., USA; Santavicca, Domenic, Pennsylvania State Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 41-1 - 41-12; In English; See also 20000020829
Contract(s)/Grant(s): N00014-96-1-0405; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Combustion instabilities have proven to be a major factor limiting the development of high performance, low emissions gas turbine engines. This is a result of the fact that our current understanding of the underlying phenomenology of unstable combustion is incomplete, making it difficult to design high performance, low emissions combustors which are stable over their entire operating range. This problem is further aggravated by the fact that achieving stable combustion in a single-nozzle test of the actual combustor hardware is not a guarantee that the full-scale engine will not exhibit instabilities. Active combustion control provides an alternate approach to the successful development of high performance, low emissions gas turbine combustion systems. In theory, an active control system can be designed without a priori understanding of the nature or phenomenology of the instability. In practice, however, the optimization of a successful active control system requires a fundamental understanding of the phenomenology of unstable combustion. particularly in the specific engine of interest and over the complete range of desired engine operating conditions. This paper presents results from a research program aimed at the development and optimization of an active control system for use in a low emissions gas turbine combustor. An overview of the control methodology is presented first. Then the theoretical model, which forms the basis of the model-based controller, is presented and preliminary results discussed. and lastly, experimental measurements of the stability characteristics of the lean premixed, dump combustor used in this study and of the response of the secondary fuel injector and the combustor to various control parameters are presented and the use of this type of information to optimize the control system is discussed.
Author
Active Control; Combustion; Combustion Stability; Combustion Chambers; Gas Turbine Engines; Premixing

20000020866 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. for Propulsion Technology, Cologne, Germany
Optical Measurements of Spray Combustion in a Single Sector Combustor from a Practical Fuel Injector at Higher Pressures
Behrendt, T., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Frodermann, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Heinze, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Lehmann, B., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Stursberg, K., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 43-1 - 43-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A research combustor for the investigation of spray combustion of practical aeroengine fuel injectors has been built. It approximates a single sector of an annular combustor. It allows optical access for laser based measuring techniques with point and planar measuring volumes and can be operated up to 20 bar with preheat temperatures of up to 850 K. For this contribution, the combustor has been operated at 3, 6 and 9 bar and at preheat temperatures of 473 K and 673 K with a technology injector supplied by BMW-RR. The isothermal flowfield was investigated by Laser Doppler Anemometry and the combusting flow by Phase Doppler Anemometry, Laser Induced Fluorescence of Kerosene and OH and imaging of the spontaneous OH emission. The injector showed a large central recirculation with an almost radial expansion of the gas flow without outer recirculation. At 6 bar, 473 K preheat and AFR 20, the bulk of the spray is evaporated before the reaction rate as signalled by OH* emission intensity reaches high values, which confirms earlier estimates postulating external group combustion for aeroengines. The investigated

atomizer shows a marked influence of temperature and almost no influence of pressure on the measured drop sizes which was attributed to the design of the internal airflow promoting prompt atomization as the dominant atomization mode.
Author
Optical Measurement; Pressure Effects; Combustion; Combustion Chambers; Combustible Flow; Fuel Injection; Air Flow; Aircraft Engines; Injectors

20000020867 Innovative Scientific Solutions, Inc., Beavercreek, OH USA
Combustion Characteristics of a Trapped Vortex Combustor
Sturgess, G. J., Innovative Scientific Solutions, Inc., USA; Hsu, K.-Y., Innovative Scientific Solutions, Inc., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 44-1 - 44-13; In English; See also 20000020829
Contract(s)/Grant(s): F33615-95-C-2507; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The lean blowout stability of a laboratory-scale version of a trapped-vortex combustor is described. Three cavity axial lengths were tested at atmospheric pressure and ambient temperature over a range of mainstream velocities from 15 to 95 m/s. For each geometry and mainstream velocity, three values of cavity jet airflow were used; 5, 10 and 15 percent of the mainstream mass flow rate respectively. Pressure transducer and microphone measurements were used to assess noise levels and acoustic coupling of heat release with cavity dynamics. Planar laser-induced fluorescence of OH was used to obtain qualitative understanding of the flame structures. It was found that at very low cavity air-jet momentum, the flow in the cavity is poorly organized and is highly subject to mainstream influences. A range of operating conditions exists where the flame at blowout is contained within the cavity, and blowout stability is high. At higher cavity mass loadings burning in the cavity is not contained and is supplemented by burning in the interfacial shear layer between mainstream and cavity flows. Blowout then is from this shear layer, and depends on the ratio of mainstream to cavity momentum and the cavity axial length, as well as cavity loading Comparison of lean blowouts with those for a swirl-stabilized combustor indicates that a well-designed trapped vortex combustor can have superior operability characteristics.
Author
Trapped Vortices; Combustion; Combustion Chambers; Jet Flow; Combustion Stability; Engine Design; Propulsion System Configurations; Air Jets

20000020869 GASTEC N.V., Apeldoorn, Netherlands
Catalytic Combustion Concepts for Industrial Gas Turbines
derKinderen, J. M., GASTEC N.V., Netherlands; vanYperen, R., GASTEC N.V., Netherlands; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 47-1 - 47-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The desire to reduce pollutants, e.g. oxides of nitrogen (NOx), carbon monoxide and unburned hydrocarbons, from gas turbine exhausts has stimulated the research into the use of catalytic combustion systems. These systems have the potential to minimise emissions of the above pollutants and have the added advantage of greatly reducing combustion induced vibrations, to which conventional low emission combustion systems are prone. The development of a catalytic combustion system for gas turbines was one of the goals in the Brite EuRam project BRE2-CT92-0309 (Catalytic Combustion Systems for Pollutant Suppression in Industrial Gas Turbines, Reformers and Radiant Heaters). Durable high temperature catalytic combustion systems, which were optimised for the combustion of natural gas in the temperature range of 700 to 1500 K, and suitable for incorporation into ultra low emissions combustion systems for high pressure ratio, high efficiency industrial gas turbines were researched. In order to meet typical combustion requirements, a multi-stage catalytic combustion system incorporating a pre-burner, one or more catalysts and a homogeneous reaction zone was envisaged. A catalytic high pressure test rig was built, which was capable of testing at a maximum of 20 - 25 bar and an outlet temperature of 1600 K. Tests showed that it was possible to reach a 100% conversion of methane with hardly any CO and NOx in the outlet stream. However, further research is required to investigate new or improved high temperature catalyst systems with high activity and excellent thermal stability and integrity.
Author
Catalysts; Combustion; Combustion Products; Contaminants; Gas Turbines

20000020872 Alfa Romeo S.p.A., Research and Development Dept., Naples, Italy
Soot Formation Modelling in Turbulent Diffusion Flames
DiMartino, P., Alfa Romeo S.p.A., Italy; Cinque, G., Alfa Romeo S.p.A., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 50-1 - 50-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The formation of soot and its emission from practical combustion devices is of interest to engineers and designers of gas turbines, diesel engines and power plants. Although advances have been made, soot formation models must skill be regarded as being far from complete because qualitative understanding of the physical processes remains uncertain. The purpose of this paper was twofold: the first step was to choose the best soot formation models in the calculation of kerosine turbulent diffusion flame, more appropriate to gas turbine combustors for aircraft engines. The next step has been the optimization on of the kinetic constants of soot models by comparing the computed results with available experimental measurements. Finally these constants have been used to couple soot and radiation in order to study the impact on local chemistry, temperature and heat transfer to the combustor walls. Comparisons with experiments concerning wall temperatures have also been performed.
Author
Diffusion Flames; Combustion Chambers; Soot; Mathematical Models; Combustion

20000020873 Karlsruhe Univ., Lehrstuhl und Inst. fuer Thermische Stroemungsmaschinen, Germany
Efficient Numerical Calculation of Evaporating Sprays in Combustion Chamber Flows
Schmehl, R., Karlsruhe Univ., Germany; Klose, G., Karlsruhe Univ., Germany; Maier, G., Karlsruhe Univ., Germany; Wittig, S., Karlsruhe Univ., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 51-1 - 51-14; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Representing two different conceptual approaches, either Eulerian continuum models or Lagrangian particle models are commonly applied for the numerical description of dispersed two phase flows. Taking advantage of the positive features inherent to each model, a combination approach is presented in this study for the efficient computation of liquid fuel sprays in combustor flows. In the preconditioning stage, Eulerian transport equations for gas phase and droplet phase are solved simultaneously in a block-iterative scheme based on a coarse discretization of spray boundary conditions at the nozzle. Due to the close coupling of both phases, the time expense of this approximate flow field computation is not much higher as for single phase flows. In the refinement stage, Lagrangian droplet tracking is applied with a detailed discretization of initial conditions. to account for complete interaction between gas phase and droplets, gas flow solution and droplet tracking are concatenated by an iterative procedure. In this stage, the numerical description of the spray is enhanced by additional modeling of droplet breakup. Results of numerical simulations are compared with measurements of the two phase flow in a premix duct of a LPP research combustor.
Author
Two Phase Flow; Combustion Chambers; Evaporation; Fuel Sprays; Continuum Modeling

20000020874 Instituto Superior Tecnico, Mechanical Engineering Dept., Lisbon, Portugal
Pollutants Emission Prediction in Combustion in Inert Porous Media
Malico, I., Instituto Superior Tecnico, Portugal; Zhou, X. Y., Instituto Superior Tecnico, Portugal; Pereira, J. C. F., Instituto Superior Tecnico, Portugal; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 53-1 - 53-8; In English; See also 20000020829
Contract(s)/Grant(s): PRAXIS-XI/BD/5885/95; PRAXIS-XXI/BPD/11846/97; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Two-dimensional predictions of flow, temperature, major species mass fractions and emissions were obtained for a porous burner. Combustion was described by the skeletal mechanism of Glarborg et al. (1992), which consists of 77 reactions and 26 species. Thermal non-equilibrium between the gas and solid phases was considered and two energy equations were solved. The discrete ordinates method was used to calculate radiation in an emitting, absorbing and isotropically scattering medium. For the two-dimensional calculations, predicted CO and NO emissions are compared with experimental values for a 7 KW thermal power and several excess air ratios. The model underpredicts the CO emissions and overpredicts the NO emissions, especially for close to stoichiometric conditions. The influence of pressure on combustion in porous media was examined using a one dimensional model for a very simple burner configuration. It may be concluded that, as the pressure is increased, the flame speed is reduced, CO emissions are decreased and NO emissions are increased.
Author
Contaminants; Two Dimensional Flow; Combustion; Gas-Solid Interactions; Porosity; Burners; Emission; Pressure Effects

20000020875 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
Characterization of Autoignition and Flashback in Premixed Injection Systems ***Caracterisation des Systemes d'Injection Premelanges en Auto-Inflammation et Remontee de Flamme***
Guin, C., Office National d'Etudes et de Recherches Aerospatiales, France; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 30-1 - 30-20; In English; In French; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Lean premixed combustors performed very well for reducing NOx emissions, but the concept is penalised by problems of autoignition and flashback, especially in motors with a high pressure ratio. In the framework of the Brite Euram programme, ONERA has therefore developed a special test facility for characterising these phenomena in premixed systems under operational conditions and independently of the combustor. The test rig allows continuous monitoring of the flow within the mixing duct by an optical system able to detect autoignition and flashback. Several concepts developed for the manufacturers Turbomeca, Volvo, BMW, Rolls-Royce and Snecma were tested in the facility. The safe operating limits for each concept were determined. This paper describes the test facility, the procedure used and the measurements made. The main parameters governing the phenomena are described and a law defining the autoignition conditions is established. A few examples of measurement records are used to explain how the results are interpreted.
Author
Combustion Chambers; Continuum Flow; Test Facilities; Ignition; Premixing; Injection; Spontaneous Combustion; Flashback; Engine Design

20000020960 National Inst. of Justice, Office of Justice Programs, Washington, DC USA
Evaluation of a Test Protocol for Explosives Trace Detectors Using a Representative Commercial Analyzer. NIJ Report 100-99: Law Enforcement and Corrections Standards and Testing Program
Eiceman, G. A.; Boyett, C. M.; Sep. 1999; 40p; In English
Report No.(s): PB2000-102215; NCJ-178261; No Copyright; Avail: National Technical Information Service (NTIS)
The Office of Law Enforcement Standards (OLES) of the National Institute of Standards and Technology (NIST) furnishes technical support to the National Institute of Justice (NIJ) program to strengthen law enforcement and criminal justice in the USA. OLESs function is to conduct research that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment. OLES is: (1) Subjecting existing equipment to laboratory testing and evaluation, and (2) conducting research leading to the development of several series of documents, including national standards, user guides, and technical reports. This document covers research conducted by OLES under the sponsorship of the National Institute of Justice. Additional reports as well as other documents are being issued under the OLES program.
NTIS
Explosives; Detectors; Analyzers

26
METALS AND METALLIC MATERIALS

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

20000015353 Florida Agricultural and Mechanical Univ., Tallahassee, FL USA
Micromechanical Modeling of Superplastic Materials ***Final Report, 15 Jul. 1996 - 14 Jul. 1999***
Chandra, Namas; Sep. 21, 1999; 127p; In English
Contract(s)/Grant(s): DAAH04-96-1-0226
Report No.(s): AD-A371489; ARO-35557.7-MS-SAH; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
In this work, superplastic deformation were studied at atomistic, mesoscopic and macroscopic levels with a special focus on the former two. At the atomistic level, we studied the energy and structure of symmetric tilt boundaries and examined the energy barriers during grain boundary sliding of Aluminum bicrystal. We also studied the effect of temperature and impurity atoms on the structure, energy and deformation of grain boundary sliding. At the mesoscopic level, polycrystal based micromechanical model was developed and append to conventional single-phase, dual-phase and high strain rate superplastic materials. This model has successfully predicted the flow-stress vs. strain rate and strain-rate sensitivity of conventional single-phase (7475 aluminium alloy, 2090-OE16 Al-Li alloy, and Al-Zn-Mg-Cu alloy), dual-phase (Ti-6Al-4V and Zn-22Al), and high strain-rate materials (IN905XL, IN9021 and IN90211). At macroscopic level, the effect of the state of strain (uniaxial or biaxial) on the origin and evolution of cavities is Al based alloys were studied. This model was also integrated with finite element code. Most of the results are available at our web site: http://amml.eng.fsu.edu. In addition, an integrated web based simulation of SP process modeling was developed and implemented.
DTIC
Aluminum Alloys; Composite Materials; Deformation; Micromechanics; Superplasticity

20000017956 NASA Marshall Space Flight Center, Huntsville, AL USA

Gold Coating of Fiber Tips in Near-Field Scanning Optical Microscopy

Vikram, C. S., NASA Marshall Space Flight Center, USA; Witherow, William K., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

We report what is believed to be the first experimental demonstration of gold coating by a chemical baking process on tapered fiber tips used in near-field scanning optical microscopy. Many tips can be simultaneously coated.

Author

Gold Coatings; Protective Coatings; Fibers; Optical Microscopes

20000020746 Army Armament Research, Development and Engineering Center, Benet Labs., Watervliet, NY USA

Observations of the Oxidation of Pure and Sputtered Tantalum Via Dilatometry

Vigilante, G. N.; Cote, P. J.; Welty, A. M.; Apr. 08, 1999; 15p; In English

Report No.(s): AD-A371038; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The oxidation of pure and sputtered tantalum foils was observed via dilatometry and weight gain measurements. Specimens were tested in both helium and laboratory air at isothermal temperatures ranging from 300 C to 850 C. Based on weight gain measurements of pure tantalum, it is apparent that oxygen saturation occurred. The activation energy for both the pure and sputtered tantalum was consistent with the activation energy for absorption rather than interstitial or grain boundary diffusion. This investigation is the precursor to subsequent dilatometry investigations on the effects on hydrogen in tantalum at elevated temperatures.

DTIC

Tantalum; Oxygen; Isotherms; Metal-Gas Systems; Metal Foils; Dilatometry; Interstitials; Oxidation; Sputtering

20000020751 Sandia National Labs., Albuquerque, NM USA

Shock Induced Melting in Aluminum: Wave Profile Measurements

Chhabildas, L. C.; Furnish, M. D.; Reinhart, W. D.; Jun. 23, 1999; 6p; In English; APS SCCM 99, Shock Compression of Condensed Matter, 27 Jun. - 2 Jul. 1999, Snowbird, UT, USA

Report No.(s): DE00-008453; SAND99-0875C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have developed launch capabilities that can propel macroscopic plates to hypervelocities (8 to 16 km/s). This capability has been used to determine the first time-resolved wave profile measurements using velocity interferometry techniques at impact velocities of 10 km/s. These measurements show that aluminum continues to exhibit normal release behavior to 161 GPa with complete loss of strength in the shocked state. Results of these experiments are discussed and compared with the results of lower pressure experiments conducted at lower impact velocities.

NTIS

Aluminum; Impact Velocity; Shock Waves

20000020753 Sandia National Labs., Albuquerque, NM USA

Aluminum Hugoniot Measurement on the Sandia Z Accelerator

Asay, J. R.; Bernard, M. A.; Clark, B. F.; Fleming, K. J.; Hall, C. A.; Jun. 23, 1999; 6p; In English; Shock Compression of Condensed Matter (SHOCK99), 27 Jun. - 2 Jul. 1999, Washington, DC, USA

Report No.(s): DE00-008449; SAND98-2861C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Aluminum has been investigated at multi-Mbar pressures through planar impacts generated by guns and explosives, and ablatively driven shocks from high energy lasers. Because it is well characterized, it is often used as a reference in relative Hugoniot measurements. to determine equation of state measurement capabilities on the Sandia Z accelerator, Hugoniot states of type 1100 aluminum were determined in the 1.8 to 4.5 Mbar range for comparisons to published data. Ablatively driven shocks on 6.5mm diameter samples were measured using velocity interferometry and laser based shock arrival sensors. In each experiment, both shock and particle velocities were independently measured to determine Hugoniot states. Many of the experiments performed had multiple measurements of these two parameters for redundancy and diagnostic validation. Results indicate agreement with the extrapolation of a previously established, lower pressure, Hugoniot within error bounds representing the experimental uncertainties.

NTIS

Aluminum; Ablative Materials; Extrapolation

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.

20000014442 Iowa State Univ. of Science and Technology, Dept. of Mechanical Engineering, Ames, IA USA
Miscibility, Solubility, Viscosity, and Density Measurements for R-236ea with Four Different Exxon Lubricants ***Final Report, Mar. 1995 - Mar. 1997***
Kang, H. M.; Pate, M. B.; Jun. 1999; 83p; In English
Contract(s)/Grant(s): CR820755-01-4
Report No.(s): AD-A371241; EPA/600/R; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The report discusses miscibility, solubility, viscosity, and density data for the refrigerant hydrofluorocarbon (HFC)-236ea (or R-236ea) and four lubricants supplied by Exxon Corporation. Such data are needed to determine the suitability of refrigerant/lubricant combinations for use in refrigeration systems. The miscibility tests were performed in a test facility consisting of a series of miniature test cells submerged in a constant temperature bath, precisely controlled over a range of -50 to 90 C. The test cells were constructed to allow for complete visibility of refrigerant/lubricant mixtures under all test conditions. Critical solution temperatures obtained from the miscibility data are presented for each refrigerant/lubricant combination. Data for the R-236ea in each of the test lubricants have been collected for refrigerant concentrations of 10-90%. The raw data have been presented, and the results have been summarized. Two of the oils (Exxon-03 and 04) were found to be completely miscible over the temperature and concentration ranges tested, while the other two (Exxon-01 and 02) were found to be immiscible over most of the temperature range tested. Solubility, viscosity, and density data were also obtained for R-236ea mixed with the same four oils for a refrigerant concentration range of 0-40 wt% refrigerant over a temperature range of 30-100 C.
DTIC
Solubility; Viscosity; Density Measurement; Lubricants

20000015354 Drexel Univ., Dept. of Materials Engineering, Philadelphia, PA USA
Microscale Plasticity and Fracture Toughness of Ti3SiC2 at Ambient and High Temperatures ***Final Report, 1 May - 31 Dec. 1997***
Barsoum, M. W.; Nov. 1999; 32p; In English
Contract(s)/Grant(s): F49620-97-1-0298; AF Proj. 2306
Report No.(s): AD-A371725; AFRL-SR-BL-TR-99-0302; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of this work was to develop a science-based understanding of the structure property relationships in Ti3SiC2. Late in 1995 we synthesized for the first time dense, bulk single phase samples of Ti3SiC2. Preliminary characterization has shown it to be a ternary compound with a unique set of properties, machinability similar to that of graphite, excellent oxidation resistance, relatively low density 4.5 gm/cu cm and non-susceptibility to thermal shock. A brittle-to-ductile transition occurs at 1200 C, and at 1300 C the material is plastic with very respectable yield points (100 and 500 MPa in flexure and compression, respectively). This combination of properties renders Ti3SiC2 an attractive candidate for a variety of high temperature structural applications of interest to the Air Force and creates the immediate need for a detailed characterization study to understand the physical origin of these properties. The evolution of deformation-microfracture damage below Hertzian contacts in a coarse-grain Ti3SiC2 was studied. The Hertzian indentation stress-strain response deviates strongly from linearity beyond a well-defined maximum, with pronounced strain-softening, indicating exceptional deformability in this otherwise (elastically) stiff ceramic. Surface and subsurface ceramographic observations reveal extensive quasi-plastic microdamage zones at the contact sites. The ternary carbide, Ti3SiC2, fabricated by a reactive hot press route was investigated by transmission electron microscopy, TEM. The material consists mainly of large elongated grains with planar boundaries and is characterized by a low defect density. Dislocations are observed in the grains and at grain boundaries. Perfect dislocations with b = 1/3 1120 lying in (0001) basal planes are present.
DTIC
Structural Design; Fracture Strength; Titanium Compounds; Silicon Carbides; Fractures (Materials)

20000017939 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Development of a low-VOC Aircraft Wheel Well Cleaner
Bevilacqua, Phillip, Jr., Naval Air Warfare Center, USA; Clark, Kenneth G., Naval Air Warfare Center, USA; Gauntt, David L., Naval Air Warfare Center, USA; Spadafora, Stepehn, Naval Air Warfare Center, USA; Mar. 24, 1999; 8p; In English
Report No.(s): AD-A368625; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An airforce wheel well cleaning gel has been developed on D-limonen, isoparaffinic hydrocarbon, and surfactants, which meets the requirements of MIL-PRF-85570C Type V. Laboratory and field-testing suggest that this product has good performance characteristic solvent-based products previously used in this application.
DTIC
Wheels; Cleaning; Cleaners

20000017978 Rochester Univ., Dept. of Chemical Engineering, NY USA
X-Ray Crystal Structures and Photophysical Properties of New Conjugated Oligoquinolines
Jenekhe, Samson A.; Shetty, Ashok S.; Liu, Elizabeth B.; Lachicotte, Rene J.; Jan. 11, 1999; 41p; In English
Contract(s)/Grant(s): N00014-94-1-0540
Report No.(s): AD-A359384; TR-46; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The synthesis, characterization, X-ray crystal structures, and photophysical properties of two conjugated oligoquinolines, 2,2'-bis(4-phenylquinoline)-1,4-phenylene (2a) and 2,2'-bis(4-phenylquinoline)-4,4'-biphenylene (2b), are reported. Both 2a and 2b crystallized in a monoclinic lattice with dfgroups. The X-ray crystal structures reveal structures reveal that 2a exhibits intermolecular face-to-face pi-pi stacking whereas 2b manifests edge-to-face pi-pi stacking. The dilute solution and solid state optical absorption and emission spectra of 2b were red-shifted from those of 2a because of the greater degrees of pi-electron delocalization and intramolecular charge transfer in 2b compared to 2a. The strongly Stokes shifted solid state emission bands of both oligomers from their absorption bands are attributed to excimer formation. These conjugated oligoquinolines with known X-ray crystal structures are excellent model systems for elucidating the structure and properties of polyquinolines and may also find device applications as n-type semiconductors.
DTIC
Oligomers; X Rays; Crystal Structure; Conjugation; Physical Properties; Quinoline

20000018003 Washington Univ., Applied Physics Lab., Seattle, WA USA
Thin Film Mediated Phase Change Phenomena: Crystallization, Evaporation and Wetting ***Final Report, 1 May 1996 - 31 Oct. 1998***
Wettlaufer, John S., Washington Univ., USA; [1998]; 5p; In English
Contract(s)/Grant(s): NAG8-1277; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
We focus on two distinct materials science problems that arise in two distinct microgravity environments: In space and within the space of a polymeric network. In the former environment, we consider a near eutectic alloy film in contact with its vapor which, when evaporating on earth, will experience compositionally induced buoyancy driven convection. The latter will significantly influence the morphology of the crystallized end member. In the absence of gravity, the morphology will be dominated by molecular diffusion and Marangoni driven viscous flow, and we study these phenomena theoretically and experimentally. The second microgravity environment exists in liquids, gels, and other soft materials where the small mass of individual molecules makes the effect of gravity negligible next to the relatively strong forces of intermolecular collisions. In such materials, an essential question concerns how to relate the molecular dynamics to the bulk rheological behavior. Here, we observe experimentally the diffusive motion of a single molecule in a single polymer filament, embedded within a polymer network and find anomalous diffusive behavior.
Author
Crystallization; Gravitational Effects; Marangoni Convection; Microgravity; Thin Films; Alloys; Wettability; Polymeric Films; Crystal Growth

20000019591 Northwestern Univ., Evanston, IL USA
New Classes of Ceramic Materials for Thermal Barrier Coating Applications ***Final Report, 10 Jul. 1997-28 Feb. 1999***
Sambasivan, Sankar; Nov. 18, 1999; 29p; In English
Contract(s)/Grant(s): F49620-97-1-0498
Report No.(s): AD-A371309; WW03; AFRL-SR-BL-TR-99-0280; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This project investigated the feasibility of using new ceramic materials/concepts for use in thermal barrier coating applications. In one approach, the effect of solid solution on thermal conductivity of refractory spinels (magnesium aluminate-based) was evaluated. Plasma spray process was used to fabricate free-standing discs of spinels with various amounts of cobalt. Preliminary results show that a 2% doping of cobalt in MgA12O4 was effective in lowering thermal conductivity. In another approach, the use of layered oxides for TBC applications was explored. Hot pressed samples of potassium calcium niobate (KCN) and another proprietary layered oxide were used to determine the k-T behavior. While both compositions showed

significantly low k values (similar to YSZ), KCN decomposed above 1200 degrees C, whereas the second layered oxide was stable at least up to 1400 degrees C. These preliminary results warrant further investigation of such new concepts/materials.
DTIC
Plasma Spraying; Coatings; Ceramics; Barrier Layers; Thermal Control Coatings

20000019592 Cincinnati Univ., Dept. of Chemistry, OH USA
Elastomeric Phases for Toughening Air Force High-Temperature Polymers ***Final Report, 30 Sep. 1996 - 29 Sep. 1999***
Kumudine, C.; Premachandra, J. K.; Mark, J. E.; Unroe, M. R.; Arnold, F. E.; Nov. 08, 1999; 55p; In English
Contract(s)/Grant(s): F49620-96-1-0235
Report No.(s): AD-A371533; AFRL-SR-BL-TR-99-0287; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy
A number of high-temperature polymers of interest and importance to the US Air Force have a degree of brittleness that limits their utilization. This brittleness was reduced, and a number of other physical properties were improved, by the in-situ introduction of dispersed elastomeric phases. This was done in a modification of the sol-gel approach previously used to modify other properties by the introduction of much harder ceramic-like phases.
DTIC
Elastomers; Polymers; Toughness

20000020749 Sandia National Labs., Albuquerque, NM USA
Measurement of the Dielectric Strength of Titanium Dioxide Ceramics
Huebner, W.; Krogh, M. L.; Lundstrom, J. M.; Pate, R. C.; Rinehart, L. F.; Jun. 24, 1999; 7p; In English; 12th; 12th IEEE International Pulsed Power Conference, 27-30 Jun. 1999, Monterey, CA, USA
Report No.(s): DE00-008457; SAND99-1536C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Titanium dioxide ceramics (T102) are candidate materials for high energy density pulsed power devices (1), Experiments to quantify the dielectric strength of Ti02 have been performed on a limited number of unoptimized samples. A high voltage test set was constructed to test the Ti02. All samples had a relative dielectric constant of 100, all samples were of 3mm nominal thickness, and all tests were performed in water dielectric to reduce the effect of the triple point field enhancement at the electrode edge. Both single layer and laminated samples were tested and the breakdown field strengths were recorded. Voltage rise times varied slightly around 400 ns depending upon the size of the test sample area. Areas varied fkom <0.2 cmz to >100 cmz. Both single layer and laminated material showed a strong area effect where the dielectric strength dropped off as area to the -0,17 and- 0,1 power respectively. Effective areas of the electrodes were calculated using a field solver program. Breakdown field strengths varied from 469 kV/cm to 124 kV/cm in the single layer specimens, and from 556 kV/cm to 261 kVlcm in the laminates over an increasing area range. Figure of merit calculations for the material show that at areas of approximately 100 cm2 the laminates can store nearly 3 times more energy than single layers.
NTIS
Titanium Oxides; Dielectric Properties; Field Strength; Ceramics

20000020754 Argonne National Lab., IL USA
Using imaging raman microscopy to explore phase evolution in composite ceramic superconductors
Fischer, A.; Maroni, V.; Wu, K.; Sep. 17, 1998; 16p; In English; 215th; 215th American Chemical Society Meeting, 29 Mar. - 2 Apr. 1998, Dallas, TX, USA
Report No.(s): DE00-008119; ANL/CMT/CP-94226; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Raman microspectroscopy and imaging Raman microscopy have proven to be powerful tools for studying the evolution and spatial distribution of chemical phases in the bismuth-based (BSCCO) and thallium-based (TBCCO) families of high-critical-temperature (high- Tc) superconducting ceramics. These techniques have been applied to compressed/sintered powders and silver-clad composite conductors in conjunction with scanning electron microscopy and energy dispersive x-ray spectroscopy. Many important insights have been gained about the identity, size, shape, orientation, and spatial distribution of the various nonsuperconducting secondary phases (NSPS) that form and dissipate during heat treatment of the BSCCO and TBCCO silver-clad composite tapes. The resuIts have aHowed us to determine key mechanistic features that influence the formation of the super- conducting phases as heat treatment progresses, incIuding the location of lead-rich NSPS and the identification of the constituent phases in certain NSP agglomerations that tend to resist dissipation as high-Tc phase formation proceeds to completion.
NTIS
Spectroscopy; High Temperature Superconductors; Composite Materials; X Ray Spectroscopy; Imaging Techniques

20000020766 Case Western Reserve Univ., Cleveland, OH USA
The Aging Process in Polymers, Positron Annihilation Lifetime Studies ***Final Report***
McGervey, John D.; Jamieson, Alex M.; Nov. 1999; 8p; In English
Contract(s)/Grant(s): DAAH04-93-G-0069
Report No.(s): AD-A371493; ARO-30748.11-MS; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

Our research effort on this project investigated the capability of positron annihilation lifetime (PAL) spectroscopy to characterize quantitatively the molecular-level structural disorder in the amorphous phase of polymer materials and to enhance our understanding of the relationships between molecular disorder and the functional properties of such materials. A particular interest was to characterize the change in free volume during isothermal annealing, which is the origin of the well-known physical aging effect in mechanical properties of polymeric glasses such as embrittlement.
DTIC
Positron Annihilation; Amorphous Materials; Spectroscopy; Aging (Materials)

20000020769 North Carolina Univ., Chapel Hill, NC USA
An NMR Study of Metallic Glasses ***Final Report, 1 Jun. 1996 - 31 Aug. 1999***
Wu, Yue; Nov. 19, 1999; 7p; In English
Contract(s)/Grant(s): DAAH04-96-1-0185
Report No.(s): AD-A371501; TR-5-36881; ARO-35117.4-MS; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

The mechanisms of atomic transport in the supercooled liquid state (SLS) and the nature of glass transition have been challenging problems for decades. It is believed that collective atomic motion plays a key role in the dramatic slow-down of kinetics near the glass transition temperature Tg. Thus, understanding the mechanisms of atomic transport is directly linked to the understanding of the glass forming ability of metallic alloys. Measurements on both macroscopic and microscopic scales are required for the understanding of atomic motions in SLS and glasses. We have developed a nuclear magnetic resonance technique, the Be-9 spin alignment echo technique (SAE), to probe slow atomic motions on microscopic scales. Systems of focus are Vitreloy 1 and Vitreloy 4, two of the Zr-Ti-Ni-Cu-Be bulk metallic glasses with extraordinary glass forming ability. by combining SAE and diffusion measurements it was revealed that long-range transport of Be atoms in the SLS is due to two diffusion processes, one of these is single-atom hopping assisted by thermal fluctuation of spread-out free volume. However, collective motion of atomic clusters dominates in the SLS. Further understanding of the influence of composition and processing on such atomic motions could lead to the improvement of glass forming ability.
DTIC
Metallic Glasses; Nuclear Magnetic Resonance

20000020773 Science Univ. of Tokyo, Japan
US-Japan Seminar (9th) on Dielectric and Piezoelectric Ceramics: Program Summary and Extended Abstract
Takenaka, Tadashi; Nov. 05, 1999; 486p; In English, 2-5 Nov. 1999, Okinawa, Japan; Sponsored in part by US Navy
Contract(s)/Grant(s): F62562--99-M-9152
Report No.(s): AD-A371641; AOARD-CSP-981028; No Copyright; Avail: CASI; A04, Microfiche; A21, Hardcopy

Proceedings from the 9th US-Japan Seminar on Dielectric & Piezoelectric Ceramics, held 2-4 Nov 99, in Okinawa, Japan, includes contributed papers pertaining to: (1) Basic Science; (2) Piezoelectric Materials and Devices; (3) Thin Film Dielectrics: (4) Multilayer Ceramic Capacitors; and (5) Advanced Processing and Packaging.
DTIC
Conferences; Dielectrics; Piezoelectric Ceramics

20000020781 Philadelphia Coll. of Textiles and Science, PA USA
A Comparative Theoretical Study of Quasi-Static and Impact Response of Laminated and Textile Composite Structures ***Final Report***
Pastore, Christopher M.; Nov. 1999; 77p; In English
Contract(s)/Grant(s): DAAH04-96-1-0057
Report No.(s): AD-A371492; ARO-35661.1-EG; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

The report presents the details of the computational algorithm for a novel three-dimensional variational dynamic analysis approach developed in computational algorithm of impact contact problem based on variational mosaic model and numerical examples. The analysis approach is aimed at solving a variety of stress analysis problems of composite structural parts under the effect of impulsive and impact loads. Some specific applications of the developed analysis are shown on the examples of transverse dynamic bending of simply supported laminated plate and 3D contact analysis for a multi-brick structure under longitudinal and

transverse longitudinal rigid body impact. Numerical results clearly show dynamic effects in response of simply supported laminated plate at high rate of transverse dynamic bending. As the rate of transverse dynamic bending decreases the response of simply supported laminated plate reduces to the corresponding benchmark static solution tensile response of 3D woven fabrics. This example shows the capability of the developed computer code to solve 3D dynamic problems for a wide range of dynamic loading rate. Numerical results for the 3D impact contact problem illustrate time variations of the target displacements, strains and stresses as well as the time variations of the projectile displacement and velocity and impact contact pressure obtained from solution of the coupled problem for mechanical system ”projectile-target”. Considered numerical examples validate applicability and verify accuracy of the developed computational algorithm and computer code.
DTIC
Laminates; Textiles; Impact Loads

20000020908 National Renewable Energy Lab., Golden, CO USA
Induced Recrystallization of CdTe Thin Films Deposited by Close-Spaced Sublimation
Mayo, B.; Oct. 26, 1998; 6p; In English; National Center for Photovoltaics Program Review Meeting, 8-11 Sep. 1998, Denver, CO, USA
Report No.(s): DE00-006606; NREL/CP-520-25635; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

We have deposited CdTe thin films by close-spaced sublimation at two different temperature ranges. The films deposited at the lower temperature partially recrystallized after CdCl2 treatment at 350C and completely recrystallized after the same treatment at 400C. The films deposited at higher temperature did not recrystallize at these two temperatures. These results confirmed that the mechanisms responsible for changes in physical properties of CdTe films treated with CdCl2 are recrystallization and grain growth, and provided an alternative method to deposit CSS films using lower temperatures.
NTIS
Cadmium Tellurides; Recrystallization; Thin Films; Deposition

20000020928 Army Armament Research, Development and Engineering Center, Benet Weapons Lab., Watervliet, NY USA
Coating Evaluation Using Analytical and Experimental Dispersion Curves *Final Report*
Knight, B.; Hussain, M.; Frankel, J.; Cox, J. F.; Braunstein, J.; Nov. 1999; 16p; In English; Presented at the 26th Annual Review of Progress in Quantitative Nondestructive Evaluation, Montreal, Canada, 25-31 July 1999. Published in Review of Progress in Quantitative Nondestructive Evaluation.
Contract(s)/Grant(s): Proj-8LRMFARD77
Report No.(s): AD-A371275; ARCCB-TR-99021; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Well-bonded or ”welded” contact and poorly bonded or ”smooth” contact bonds were studied. As examples of welded contact bonds, we used sputtered tantalum and electrodeposited high contraction chromium coatings that were deposited onto steel substrates under controlled conditions. In order to simulate smooth contact coatings, thin sheets of nickel and tantalum were epoxied to copper and steel substrates, respectively. We used the method originated by Cielo et al. to gather data consisting of laser generation of the surface waves in an annular ring and laser detection in the center. Wavelet techniques were used on the surface wave-detected signals in order to obtain the experimental dispersion (velocity-frequency) curves. The experimental dispersion curves were compared to theoretical curves to give insight into the bond quality. It was found that the experimental results correlated well with the theory for the welded case.
DTIC
Protective Coatings; Evaluation; Chromium; Electrodeposition

20000021033 Army Armament Research, Development and Engineering Center, Benet Weapons Lab., Watervliet, NY USA
Thermal Damage and Shear Failure of Chromium Plated Coating on an A723 Steel Cannon Tube *Final Report*
Underwood, John H.; Parker, Anthony P.; Jul. 1999; 23p; In English; To be presented at the ASME Pressure Vessels and Piping Conference, Boston, MA. 1-5 August 1999. to be published in proceedings of the conference. Prepared in collaboration with the Royal Military College of Science, Cranfield University, Swindon UK.
Report No.(s): AD-A367743; ARCCB-TR-99013; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Degradation of the electroplated chromium coating at the bore of A723 steel cannon barrels is characterized here following cannon firing and used to model the coating failure process. Transient thermal stresses due to firing are calculated using one-dimensional heat flow analysis and used as input to a shear failure model of the coating/substrate couple. The cracking array that develops in the coating and substrate with repeated thermal cycles, the configuration of cracked segments of the coating, and the elevated temperature properties of the coating and substrate are considered in the shear failure model. Accordingly, the coating failure behavior predicted from the model is compared with the observations of coating failure mechanisms from actual fired

cannon tubes. The results of the investigation show that growth of hydrogen cracks in the steel under the chromium coating allows broadening of cracks in the coating, and subsequent shear failure of the steel under a segment of coating due to transient thermal stresses. Loss of coating segments then leads to rapid hot gas erosion of the steel and loss of function of the cannon tube. The objective is to model the final critical phase of thermal damage imparted to a chromium coating on a cannon bore that leads to the separation of a segment of coating.
DTIC
Steels; Failure; Chromium; Damage

28
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.

20000014432 National Inst. for Occupational Safety and Health, Pittsburgh, PA USA
Effects of Temperature and Aging on Emulsified Liquid Oxidizing Solutions Containing More Than 70 Percent Ammonium Nitrate Solutions with More Than 0.4 Percent Combustible Substances ***Interim Report***
Watson, R. W., National Inst. for Occupational Safety and Health, USA; Sep. 1999; 18p; In English
Report No.(s): PB2000-101808; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The shock and thermal sensitivity of three different emulsified liquid oxidizing solutions was examined using tests selected from the United Nations 'Manual of Tests and Criteria'. The solutions are used as raw materials in the manufacture of explosive blasting agents and were tested in the 'as received' condition at ambient and elevated temperatures (150 F); tests were also conducted on samples aged for 30 and 60 days. None of the samples exhibited any marked sensitivity to explosive shock. However, there was some indication of thermal sensitivity in heavily confined samples exposed to the action of 20 and 10 g black powder igniters. None of the samples exhibited any significant increase in sensitivity when tested at elevated temperatures or after aging. Plans are being made to test additional samples.
NTIS
Temperature Effects; Oxidation; Ammonium Nitrates; Combustion; Emulsions; Materials

20000017942 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
One-Liter Test: A Mid-Scale Safety Characterization Test For Melt-Castable Explosives ***Final Report, Oct. 1997 - Mar. 1998***
McKenney, Robert L., Jr; Krawitz, Thomas R.; Jul. 1999; 28p; In English
Contract(s)/Grant(s): Proj-2502
Report No.(s): AD-A367075; AFRL-MN-EG-TR-1999-7049; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The One-Liter test was developed as a mid-scale safety characterization test specifically for use with melt-castable explosives. It is a one-dimensional test carried out under relatively unconfined conditions that are similar to those encountered in melt casting operations. The test allows the researcher to assess the response of the explosive to a controlled thermal stimulus under laboratory-like conditions and, more importantly, to determine its critical temperature. The latter is defined as the lowest constant surface temperature at which a material of a specific size, shape and composition can self-heat catastrophically. This test allows one to validate kinetic and thermal parameters determined by standard small-scale laboratory experiments. These parameters are necessary to predict the critical temperatures associated with large scale melt cast operations. The experimental critical temperature of the explosive used in this report to demonstrate the use of the One-Liter test falls in the temperature range 152-155 C. Critical temperatures for large-scale melt casting operations up to 100 gallons are predicted.
DTIC
Critical Temperature; Casting; Characterization; Octol (Explosive); Melting

20000019662 National Defence Research Establishment, Avd. foer Vapen och Skydd, Tumba, Sweden
Potassium Additives to Obtain Propellants with Electrically Conducting Reaction Products. Preparation and Thermochemical Calculations ***Kaliumfoereningar som Tillsats foer att Erhalla Krut med Elektriskt Ledande Reaktionsprodukter. Tillverkning och Termokemiska Beraekningar***
Sanden, R.; Andreasson, S.; Mar. 1999; 32p; In Swedish
Report No.(s): PB2000-101257; FOA-R-99-01084-310-612-SE; No Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

This report is part of a work on preparing solid propellants with higher electric conductivity in the flame and the reaction products. This is of special interest in fields concerning combustion and electric energy interaction, e.g. ETC (electrothermal-chemical gun launch techniques) and MHD (magnetohydrodynamic) generators. by adding easily ionized alkali metals and avoiding halogens, the density of free electrons in the reactions products, and as a result the electric conductivity, is increased. The first part of the present report describes laboratory scale preparation of propellants containing potassium dinitramide (KDN), while the second part treats thermochemical calculations on propellant compositions with KDN, KNO, KCI, HMX and aluminum additives.
NTIS
Potassium; Additives; Reaction Products; Solid Propellants; Thermochemistry; Chemical Engineering

20000019669 National Renewable Energy Lab., Golden, CO USA
Experience with Bi-Fuel LPG Pickups in Texas
Whalen, P.; May 12, 1999; 4p; In English
Report No.(s): DE00-009405; NREL/FS-540-24226; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The State of Texas requires state agencies to purchase alternative fuel vehicles (AFVs). In 1996, Texas Department of Transportation (TXDOT) representatives added about 400 bi-fuel liquefied petroleum gas (LPG) pickup trucks to their fleet. The fleet managers were willing to share information about their fleets and the operation of these vehicles, so a study was launched to collect operations, maintenance, and cost data for selected LPG and gasoline vehicles (as controls) throughout 18 months of vehicle operation. This case study presents the results of that data collection and its subsequent analysis.
NTIS
Trucks; Fuels; Substitutes; Alternatives

20000019670 National Renewable Energy Lab., Golden, CO USA
Texas Bi-Fuel Liquefied Petroleum Gas Pickup Study *Final Report*
Popova, E. T.; Matthews, R. D.; Huang, Y.; May 24, 1999; 85p; In English
Report No.(s): DE00-009552; NREL/SR-540-26003; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Alternative fuels may be an effective means for decreasing America's dependence on imported oil; creating new jobs; and reducing emissions of greenhouse gases, exhaust toxics, and ozone-forming hydrocarbons. However, data regarding in-use fuel economy and maintenance characteristics of alternative fuel vehicles (AFVs) have been limited in availability. This study was undertaken to compare the operating and maintenance characteristics of bi-fuel vehicles (which use liquefied petroleum gas, or propane, as the primary fuel) to those of nominally identical gasoline vehicles. In Texas, liquefied petroleum gas is one of the most widely used alternative fuels. The largest fleet in Texas, operated by the Texas Department of Transportation (TXDOT), has hundred of bi-fuel (LPG and gasoline) vehicles operating in normal daily service. The project was conducted over a 2-year period, including 18 months (April 1997-September 1998) of data collection on operations, maintenance, and fuel consumption of the vehicles under study. This report summarizes the project and its results.
NTIS
Trucks; Fuels; Substitutes; Alternatives; Texas

20000020843 Karlsruhe Univ., Lehrstuhl und Inst. fuer Thermische Stroemungsmaschinen, Germany
Validation and Application of a Droplet Evaporation Model for Real Aviation Fuel
Prommersberger, K., Karlsruhe Univ., Germany; Maier, G., Karlsruhe Univ., Germany; Wittig, S., Karlsruhe Univ., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 16-1 - 16-13; In English; See also 20000020829
Contract(s)/Grant(s): DFG-SFB-167; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Fuel droplet dispersion and evaporation within the premix duct of a Lean Premixed Prevaporized (LPP) combustor is investigated both experimentally and numerically with a two phase flow code. Mean droplet velocity and diameter distribution have been measured in different axial planes with a Phase Doppler Particle Analyzer. The data of the droplet and gas flow measurements near the nozzle is used to establish the boundary conditions for the simulation. The two phase flow is calculated using a Lagrangian type particle tracking method. For the first time an evaporating fuel spray is simulated by the Distillation Curve evaporation model. Based on fuel property data, this model allows the consideration of the multicomponent behavior of aviation fuels. Downstream measurements of droplet size, volume flux and velocity are compared with the numerical results. The objective of the study is to present the simulation of a fuel spray evaporation process inside a LPP duct with reasonable computational effort. The numerical calculation of spray propagation and evaporation demonstrates, that the Distillation Curve evaporation model is

able to cover typical multicomponent behavior of aviation fuels under realistic operating conditions. The comparison with the experimental data shows that for the given high relative velocities between gas phase and droplets secondary droplet breakup has to be taken into account.
Author
Aircraft Fuels; Fuel Sprays; Drop Size; Two Phase Flow; Evaporation; Computerized Simulation; Mathematical Models; Gas Flow; Atomizing

20000020868 Rolls-Royce Ltd., Derby, UK
European Evaluation of JP8+100 Fuel and its Impact on Engine/Fuel System Design
Bullock, S. P., Rolls-Royce Ltd., UK; Hobday, A., Rolls-Royce Ltd., UK; Lewis, C., Rolls-Royce Ltd., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 45-1 - 45-11; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

High performance aircraft use fuel as the primary heat sink for airframe power and engine lubrication system cooling. Air cooling incurs severe cost, weight and performance penalties. Current engines therefore use all the heat sink capability of the fuel and consequently stress the fuel throughout the system. The resulting high temperatures cause fuel to form deposits reducing system performance and blocking injectors. Advanced engine design calculations indicate that fuel stability will soon become an engine performance limit. The USAF are therefore coordinating the development of additives that enhance thermal/oxidative stability to overcome this limit. These are designated as ”+100” signifying the target of improving operating temperature capability by 100 F. Evaluation of these additives has been carried out at RR plc under MOD/DERA funding. Testing so far has evaluated thermal stability enhancement using the Aviation Fuel Thermal Stability Test Unit. This test unit simulates the thermal stresses found in actual fuel system components and injectors. Test modules mimic the responses to fuel deposition found in actual systems to provide prediction of long term performance. Effectiveness of the additive tested was evaluated in blends based on two European fuels of contrasting stability. Testing the additive demonstrated additives provided a significant reduction in deposition compared to base fuel in a variety of regimes. However, blends still had definite stability limits. Results also identified novel operational aspects including additive cleaning effects during transition from normal to additised fuel. Future tests are planned to evaluate alternative additive formulations and expand testing conditions to include mission cycling, reheat system and simulated flow recirculating conditions.
Author
JP-8 Jet Fuel; Cooling; Engine Design; Fuel Systems; Operating Temperature; Fuel Tests; Thermal Stability; Additives

20000020870 Pisa Univ., Dipt. di Energetica, Italy
Modification of the Fuel Control System of a Gas Turbine Engine from Kerosene to Hydrogen
Dini, Dino, Pisa Univ., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 48-1 - 48-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Fuels for engines of road vehicles, as well of boats or aircraft, based on oil derivatives, are well known as essential factors for the air pollution. In order to adapt a gas turbine engine for the lowest emission operation, its fuel control system has to be modified from the use of a hydromechanical kerosene controller (not able to control gaseous hydrogen) into a digital system for gaseous hydrogen, consisting of an electronic control box which will modulate an electrical/pneumatical valve as a function of engine speed. This is described in the paper, as it has been tested in our laboratory, especially regarding experimental arrangements and measurements. Problems with the ignition of the oxyhydrogen gas have been solved, and the gain factors for the digital control laws were calculated using measured performance data of the kerosene driven engine. Finally, a safe 202 kW gas turbine engine is now running with gaseous hydrogen. Details of the combustion tests of the gaseous hydrogen at the operating performance are given. The data were taken upon pressure losses of the fuel nozzles, ignition performance, temperature distributions at the combustor outlet, combustion efficiency, liner wall temperature distributions, NOx emission level, noise level, operating performance, etc.
Author
Controllers; Electronic Control; Fuel Control; Gas Turbine Engines; Combustion; Hydrogen Fuels; Exhaust Emission; Digital Systems; Environment Effects

20000020891 Energy Information Administration, Office of Energy Markets and End Use, Washington, DC USA
Short-Term Energy Outlook: Quarterly Projections
Oct. 1999; 86p; In English
Report No.(s): PB2000-101776; DOE/EIA-0202(99/4Q); No Copyright; Avail: National Technical Information Service (NTIS)

The forecast period for this issue of the Outlook extends from October 1999 through December 2000. Data values for the third quarter 1999, however, are preliminary EIA estimates (for example, some monthly values for petroleum supply and disposition are derived in part from weekly data reported in EIA's Weekly Petroleum Status Report) or are calculated from model simulations that use the latest exogenous information available (for example, electricity sales and generation are simulated by using actual weather data). The historical energy data, compiled in the October 1999 version of the Short-Term Integrated Forecasting System (STIFS) database, are mostly EIA data regularly published in the Monthly Energy Review, petroleum Supply Monthly, and other EIA publications. Minor discrepancies between the data in these publications and the historical data in this Outlook are due to independent rounding.
NTIS
Meteorological Parameters; Renewable Energy

20000021016 Colorado Univ., Dept. of Mechanical Engineering, Boulder, CO USA
Structure of Partially Premixed Flames and Advanced Solid Propellants ***Final Report, 1 Dec. 1997 - 30 Nov. 1998***
Branch, Melvyn C., Colorado Univ., USA; Dreyer, Christopher B., Colorado Univ., USA; Nov. 30, 1998; 18p; In English
Contract(s)/Grant(s): F49620-98-1-0069; AF Proj. 2308
Report No.(s): AD-A367085; CCER-99-04; AFRL-SR-BL-TR-99-0201; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The combustion of solid rocket propellants of advanced energetic materials involves a complex process of decomposition and condensed phase reactions in the solid propellant, gaseous flame reactions above the propellant surface, and subsequent mixing and flow through the combustion chamber. The response to combustion instabilities is influenced by the structure of the premixed and partially premixed diffusion flames and triple flames at the propellant surface. This research provided experimental data and modeling of partially premixed diffusion flames supported by nitrogen oxides that are common with advanced solid propellants. of particular interest was the stability and possible extinction of the flames in the presence of velocity fluctuations across the propellant. It was shown that premix flames of highly disparate equivalence ratio can be supported in opposed-flow geometry and will form a triple flame structure. Evidence was presented which indicates that a diffusion flame forms between the premix flames and is due to the conversion of H2, O2, and CO originating from the premix flame zones to H20 and CO2.
DTIC
Solid Propellant Combustion; Solid Propellants; Premixing; Diffusion Flames

29
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.

20000019565 NASA Marshall Space Flight Center, Huntsville, AL USA
Reduction of Sample Rotation in Electrostatic Levitation
Hyers, R. W, NASA Marshall Space Flight Center, USA; Johnson, W. L., California Inst. of Tech., USA; Savage, L., NASA Marshall Space Flight Center, USA; Rogers, J. R., NASA Marshall Space Flight Center, USA; [2000]; 1p; In English, 14 Mar. 2000, Nashville, TN, USA; Sponsored by Metalurgical Society, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

In many containerless processing systems, control of sample rotation is an important issue. Sample rotation is even more important for microgravity containerless processing systems, where the centrifugal acceleration can approach 1 g for even a small rotation rate. Prior work on rotation control by Rhim focused on driving the sample rotation at a controlled rate for droplet dynamics experiments and measurement of electrical conductivity. His technique allows controlled, fast rotation, but for many microgravity experiments the goal is zero rotation. to minimize sample rotation, two approaches are apparent: first, to identify and balance or eliminate the driving forces for undesired sample rotation, or second, implement a feedback-based rotation control loop in parallel with the position control loop. In this work, we have taken the first approach. to minimize sample rotation, the simplest approach is to identify and balance or eliminate the driving forces for undesired sample rotation. Our experiments show that the dominant driving force for rotation of machined Zr spheres in the MSFC ESL is photon pressure from the heating laser.

Experimental results showing the correlation between heating power and torque are compared to theoretical predictions, and a strategy for minimizing the torque due to photon pressure is presented.
Author
Electrostatics; Levitation; Microgravity; Rotation; Containerless Melts; Photons

20000019569 NASA Marshall Space Flight Center, Huntsville, AL USA
Friction Stir Welding for Aluminum Metal Matrix Composites (MMC's): MSFC Center Director's Discretionary Fund *Final Report*
Lee, J. A., NASA Marshall Space Flight Center, USA; Carter, R. W., NASA Marshall Space Flight Center, USA; Ding, J., NASA Marshall Space Flight Center, USA; December 1999; 1p; In English
Contract(s)/Grant(s): Proj. 98-09
Report No.(s): NASA/TM-1999-209876; NAS 1.15:209876; M-953; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

This technical memorandum describes an investigation of using friction stir welding (FSW) process for joining a variety of aluminum metal matrix composites (MMC's) reinforced with discontinuous silicon-carbide (SiC) particulate and functional gradient materials. Preliminary results show that FSW is feasible to weld aluminum MMC to MMC or to aluminum-lithium 2195 if the SiC reinforcement is is less than 25 percent by volume fraction. However, a softening in the heat-affected zone was observed and is known to be one of the major limiting factors for joint strength. The pin tool's material is made from a low-cost steel too] H-1 3 material, and the pin tool's wear was excessive such that the pin tool length has to be manually adjusted for every 5 ft of weldment. Initially, boron-carbide coatings was developed for pin tools, but it did not show a significant improvement in wear resistance. Basically, FSW is applicable mainly for butt joining of flat plates. Therefore, FSW of cylindrical articles such as a flange to a duct with practical diameters ranging from 2-5 in. must be full), demonstrated and compared with other proven MMC joining techniques for cylindrical articles.
Author
Aluminum; Friction Welding; Metal Matrix Composites; Pins; Welded Joints; Fiber Composites; Silicon Carbides; Functionally Gradient Materials

20000019574 National Inst. of Standards and Technology, Building and Fire Research Lab., Gaithersburg, MD USA
Combustion of a Polymer (PMMA) Sphere in Microgravity *Final Report*
Yang, Jiann C., National Inst. of Standards and Technology, USA; Hamins, Anthony, National Inst. of Standards and Technology, USA; Donnelly, Michelle K., National Inst. of Standards and Technology, USA; December 1999; 48p; In English
Contract(s)/Grant(s): NASA Order C-32017-C; RTOP 962-22-00
Report No.(s): NASA/CR-1999-209403; NAS 1.26:209403; E-11925; NISTIR-6331; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of low gravity, aircraft-based, experiments was conducted to investigate the combustion of supported thermoplastic polymer spheres under varying ambient conditions. The three types of thermoplastic investigated were polymethylmethacrylate (PMMA), polypropylene (PP). and polystyrene (PS). Spheres with diameters ranging from 2 mm to 6.35 mm were tested. The total initial pressure varied from 0.05 MPa to 0. 15 MPa whereas the ambient oxygen concentration varied from 19 % to 30 % (by volume). The ignition system consisted of a pair of retractable energized coils. Two CCD cameras recorded the burning histories of the spheres. The video sequences revealed a number of dynamic events including bubbling and sputtering, as well as soot shell formation and break-up during combustion of the spheres at reduced gravity. The ejection of combusting material from the burning spheres represents a fire hazard that must be considered at reduced gravity. The ejection process was found to be sensitive to polymer type. All average burning rates were measured to increase with initial sphere diameter and oxygen concentration, whereas the initial pressure had little effect. The three thermoplastic types exhibited different burning characteristics. For the same initial conditions, the burning rate of PP was slower than PMMA, whereas the burning rate of PS was comparable to PMMA. The transient diameter of the burning thermoplastic exhibited two distinct periods: an initial period (enduring approximately half of the total burn duration) when the diameter remained approximately constant, and a final period when the square of the diameter linearly decreased with time. A simple homogeneous two-phase model was developed to understand the changing diameter of the burning sphere. Its value is based on a competition between diameter reduction due to mass loss from burning and sputtering, and diameter expansion due to the processes of swelling (density decrease with heating) and bubble growth. The model relies on empirical parameters for input, such as the burning rate and the duration of the initial and final burning periods.
Author
Burning Rate; Combustion; Ignition Systems; Microgravity; Spheres; Thermoplasticity; Polymethyl Methacrylate

20000019603 NASA Marshall Space Flight Center, Huntsville, AL USA

Microgravity Studies Offer Insights into Solidification Phenomena and Processing of Metals and Alloys

Grugel, Richard N., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The paper reviews historical aspects of solidification processing and the detrimental attributes associated with gravity-driven flow phenomena. Benefits of and avenues toward conducting experiments in a microgravity environment are presented and illustrated with relevant examples. Finally, some comments regarding the role of microgravity experimentation are given.

Author

Microgravity; Solidification; Low Gravity Manufacturing; Gravitational Effects

31
ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see categories 32 through 39.

20000015409 Research Inst. of National Defence, Div. of Defence Analysis, Stockholm, Sweden

Flexible Manufacturing: On Increasing the Production of Combat Vehicles and Starting Production of a New Missile

Flexibel Produktion: Om att Oeka Produktionen av Pansarfordon och att Boerja Producera Jaktrobotar

Hedvall, M.; Nov. 1998; 54p; In Swedish

Report No.(s): PB2000-101432; FOA-R-98-00907-170-SE; No Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

FOA has been commissioned to study the ability of Swedish defence industry to increase production of combat vehicles and start production of a new missile in a period of five years. FOA has also been commissioned to identify factors restriction the industry's ability to adjust its production to new demands. According to the results, there will be certain difficulties in increasing the production of combat vehicles. to be able to increase the production, the industry has to invest in new production equipment which takes time. A condition for the industry to be able start production of a new missile is that it participates in international cooperation projects.

NTIS

Missiles; Defense Industry; Combat; Industries; Manufacturing; Industrial Management; Production Management; Production Engineering

20000015412 Rensselaer Polytechnic Inst., Dept. of Environmental and Civil Engineering, Troy, NY USA

Site Factors and Site Categories in Seismic Codes

Dobry, R.; Ramos, R.; Power, M. S.; Jul. 19, 1999; 126p; In English

Report No.(s): PB2000-101705; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

The report discusses some of the evidence on amplification of earthquake motions due to local soils which culminated in the new definitions of site categories and site coefficients, F(sub a) and F(sub v), incorporated, first in the 1994 NEHRP Recommended Provisions for Seismic Regulations for New Buildings, and more recently in the 1997 NEHRP and 1997 Uniform Building Code (UBC). These site categories and site coefficients are described and compared to previous code provisions. Preliminary results of recent studies are discussed including averages and ranges of site coefficients calculated from recordings of the 1994 Northridge earthquake, which generally validate the 1994 NEHRP values. The possibility of performing similar calculations of site coefficients from available recordings of the 1995 Kobe, Japan earthquake is also discussed. Use of the low period site coefficient, F(sub a) in conjunction with de-aggregated measures of the seismic hazard on rock are suggested for evaluation of soil liquefaction in seismic codes. Areas needing further research are suggested. Finally, it is recommended that the seismic design provisions contained in the 1996 AASHTO Standard Specifications for Highway Bridges be updated to be consistent with the 1994 and 1997 NEHRP and 1997 UBC provisions for site categories and site coefficients.

NTIS

Earthquakes; Amplification; Sites

20000017953 Applied Research Associates, Inc., Albuquerque, NM USA

Characterization of Impact Fragmentation

Grady, D. E., Applied Research Associates, Inc., USA; Winfree, N. A., Applied Research Associates, Inc., USA; [2000]; 1p; In English; 2000 Pressure Vessels and Piping Conference, 23-27 Jul. 2000, Seattle, WA, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): NAS8-00065; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The impact of a projectile on a stationary structure at high velocity results in the energetic expulsion of fragments. The lethality of this secondary debris is of paramount concern in a range of applications. Although more broadly applicable, the present development focuses primarily on the concern of orbital debris impacting external components of space-craft structures, such as shielding and radiators. In this study, relations based on fundamental physical principles are utilized to develop statistical predictions of secondary debris size, momentum and trajectory. The underlying physics are those utilized in studies of impact mechanics, shock thermodynamics and statistical fragmentation. Equations from impact mechanics lead to predictions for mass of the secondary fragment debris, global momentum and divergent kinetic energy. Relations from shock thermodynamics are used to estimate the temperature and mass fractions of solid, liquid and vapor components. Statistics based on a Maxwell-Boltzmann distribution of energy are pursued to characterize the inherently stochastic fragmentation event, emphasizing the extremes of size and velocity. Computational simulations of impact events and data from impact fragmentation experiments are exploited in validating the assumptions that are made and the resulting impact fragmentation model.

Author

Maxwell-Boltzmann Density Function; Projectiles; Space Debris; Impact Damage; Energy Distribution; Statistical Mechanics; Thermodynamics; Mathematical Models

20000017954 Alabama Univ., Dept. of Civil and Environmental Engineering, Huntsville, AL USA

Effects of High Temparature on the Tensile Bahavior of Cment-Based Materials

Toutanji, Houssam A., Alabama Univ., USA; Effinger, Michael R., NASA Marshall Space Flight Center, USA; [2000]; 1p; In English; Cement and Concrete Technology in the 2000s, 6-10 Sep. 2000, Istanbul, Turkey; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Environmental effects such as freeze and low temperature, UV radiation, and high humidity can significantly affect structural integrity and long-term performance of concrete columns. to achieve more durable and economical structures, a new type of structural concrete columns is being developed for new construction. They are made of concrete columns encased with PVC-fiber reinforced polymer (FRP) tubes. The PVC tubes are strengthened by externally wrapping them with 8 mm wide FRP strips at different spacing. The 8 mm FRP strips are spaced at different distances: 30, 40, 50, 60 and 80 mm center-to-center. Test variables are the type of fiber, the volume of fiber, and the spacing between the FRP strips. The PVC tubes reinforced with FRP act as formwork, protective jackets and confining elements. Test results show that the external confinements of concrete columns by PVC-FRP tubes results in enhancing compressive strength, ductility and energy absorption capacity and improving durability over the conventional methods. Equations to predict the compressive strength and failure strain, as well as the entire stress-strain curve behavior of concrete confined with PVC reinforced with FRP were developed. Comparison between the experimental results and those of analytical indicates that the proposed models provide satisfactory predictions of ultimate compressive strength, failure strain and stress-strain response.

Author

Compressive Strength; Durability; Stress-Strain Relationships; Cements; Polyvinyl Chloride; Reinforcing Fibers; Tensile Strength; High Temperature

20000019568 NASA Marshall Space Flight Center, Huntsville, AL USA

Low-Pressure Gas Effects in the Potency of an Electron Beam Against Ceramic Cloth

Nunes, A. C., Jr., NASA Marshall Space Flight Center, USA; Russell, C. K., NASA Marshall Space Flight Center, USA; Zimmerman, F. R., NASA Marshall Space Flight Center, USA; Fragomeni, J. M., Ohio Univ., USA; November 1999; 1p; In English

Report No.(s): NASA/TM-1999-209762; NAS 1.15:209762; M-951; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

An 8-kv electron beam with a current in the neighborhood of 100 mA from the Ukrainian space welding ”Universal Hand Tool” (UHT) burned holes in Nextel AF-62 ceramic cloth designed to withstand temperatures up to 1,427 C. The burnthrough time was on the order of 8 sec at standoff distances between UHT and cloth ranging from 6-24 in. At both closer (2 in.) and farther (48 in.) standoff distances the potency of the beam against the cloth declined and the burnthrough time went up significantly. Prior to the test it had been expected that the beam would lay down a static charge on the cloth and be deflected without damaging the cloth. The burnthrough is thought to be an effect of partial transmission of beam power by a stream of positive ions generated by the high-voltage electron beam from contaminant gas in the ”vacuum” chamber. A rough quantitative theoretical computation appears to substantiate this possibility.

Author

Combustion; Electron Beams; Fabrics; Positive Ions; Damage; Burnthrough (Failure)

20000019661 Buffalo Univ., Multidisciplinary Center for Earthquake Engineering Research, NY USA
Proceedings of the US-Italy Workshop on Seismic Protective Systems for Bridges
Friedland, J. M.; Constantinou, M. C.; Nov. 03, 1998; 482p; In English, 27-28 Apr. 1998, New York City, NY, USA
Contract(s)/Grant(s): DTFH61-92-C-00106
Report No.(s): PB2000-101711; MCEER-98-0015; No Copyright; Avail: CASI; A04, Microfiche; A21, Hardcopy

This report presents the proceedings of the U.S.-Italy Workshop on Seismic Protective Systems for Bridges, which was held at Columbia University in New York City, New York on April 27 and 28, 1998. The workshop consisted of presentations of 13 US and 11 Italian papers which focused on research and the application of seismic protective systems for bridges, and the state-of-the-art and practice in bridge seismic isolation and energy dissipation in the two countries. Presentations were also made on the related subjects of: active control systems applications; the use of other advanced technologies for improving the seismic performance of bridges including the use of composites and rocking-column concepts; and the development of bridge fragility curves applicable to the performance of bridges with protective systems. Discussions were held on each major topic as well as the following subjects: (1) comparison of and the differences between design philosophies and practice in each country, and (2) written guidelines, standards, and codes of practice currently in use in the two countries.
NTIS
Conferences; Seismic Energy; Bridges (Structures); Earthquakes

20000020689 NASA Glenn Research Center, Cleveland, OH USA
1998 NASA Seal/Secondary Air System Workshop, Volume 1
Steinetz, Bruce, NASA Glenn Research Center, USA; Hendricks, Robert, NASA Glenn Research Center, USA; July 1999; 442p; In English; Seal/Secondary Air System, 22-23 Oct. 1998, Cleveland, OH, USA
Contract(s)/Grant(s): RTOP 523-21-13
Report No.(s): NASA/CP-1999-208916/VOL1; E-11666/VOL1; NAS 1.55:208916/VOL1; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

The 1998 NASA Seal/Secondary Air System Workshop was divided into three major areas with limited materials presented in Volume II: (1) overviews of the (NASAs high speed research (HSR) and DOE's advanced turbine engine systems (ATS)) gas turbine programs and the general aviation program (GAP) with emphasis on sealing methods and results; (2) sealing concepts and methods and results including experimental facilities and numerical predictions; and (3) reviews of the numerical engine simulation and aerospace vehicles and concepts (Trailblazer, Bantam, and X-38).
Author
Numerical Analysis; General Overviews; Gas Turbine Engines; Aerospace Vehicles; NASA Programs; Seals (Stoppers)

20000020708 NASA Glenn Research Center, Cleveland, OH USA
The Trailblazer Program
Trefney, Charles J., NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 365-379; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the "Three Pillars of Success" for the Trailblazer Program. The topics include: 1) The "Rocket Equation" for SSTO (Single Stage To Orbit); 2) The Rocket I* Barrier; 3) Rocket-Based Combined-Cycle Engine; 4) Potential for Reusability; 5) Factors Mitigating RBCC Performance; 6) The "Trailblazer" Program; 7) Trailblazer Performance Goals; 8) Trailblazer Reference Vehicle; and 9) Trailblazer Program Architecture.
CASI
Rocket-Based Combined-Cycle Engines; Single Stage to Orbit Vehicles; Propulsion System Performance; Trailblazer 1 Reentry Vehicle

20000020760 Idaho National Engineering Lab., Idaho Falls, ID USA
Low-Cost Methane Liquefaction Plant and Vehicle Refueling Station
Wilding, B.; Bramwell, D.; Jan. 01, 1999; 16p; In English
Report No.(s): DE00-005764; INEEL/EXT-99-00084; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Idaho National Engineering and Environmental Laboratory (INEEL) is currently negotiating a collaborative effort with Pacific Gas and Electric (PG and E) that will advance the use of liquefied natural gas (LNG) as a vehicle fuel. We plan to develop and demonstrate a small-scale methane liquefaction plant (production of 5,000 to 10,000 gallons per day) and a low-cost ($150,000) LNG refueling station to supply fuel to LNG-powered transit buses and other heavy-duty vehicles. INEEL will

perform the research and development work. PG and E will deploy the new facilities commercially in two demonstration projects, one in northern California, and one in southern California.
NTIS
Liquefied Natural Gas; Low Cost; Methanation; Refueling; Methane

20000020829 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Gas Turbine Engine Combustion, Emissions and Alternative Fuels ***La Combustion dans les Turbomoteurs, les Emissions et les Carburants de Remplacement***
June 1999; 608p; In English; In French, 12-16 Oct. 1998, Lisbon, Portugal; See also 20000020830 through 20000020875; Original contains color illustrations
Report No.(s): RTO-MP-14; AC/323(AVT)TP/10; ISBN 92-837-0009-0; Copyright Waived; Avail: CASI; A99, Hardcopy; A06, Microfiche

The symposium dealt with Gas Turbine Engine Combustion, Emissions, and Alternative Fuels. Forty-six papers and a Keynote Address elucidated the role of the combustion process as a crucial factor of engine performance and operability under various conditions including non-standard, new fuels, and environmental effects of civil and military interest. There were 12 Sessions covering the following topics (some in 2 sessions): Gas Turbines in Land, Sea and Air Applications, Low-Emission Combustors, Combustion Modelling, Optical Measurements, Emissions, Combustor Design, Ignition Processes, Active Combustion Control, and Alternative Fuels
Author
Gas Turbine Engines; Conferences; Combustion; Fuels; Exhaust Emission

20000020907 National Renewable Energy Lab., Golden, CO USA
Development of LNG-Powered Heavy-Duty Trucks in Commercial Hauling
Detroit Diesel Corporation; Trucking Research Institute; Dec. 03, 1998; 6p; In English
Report No.(s): DE00-007073; NREL/SR-540-25154; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

In support of the U.S. Department of Energy's development, deployment, and evaluation of alternative fuels, NREL and the Trucking Research Institute contracted with Detroit Diesel Corporation (DDC) to develop and operate a liquid natural gas fueled tractor powered by a DDC Series 50 prototype natural gas engine. This is the final report on the project.
NTIS
Trucks; Liquefied Natural Gas; Fuels

20000020911 National Renewable Energy Lab., Golden, CO USA
Additional Development of a Dedicated Liquefied Petroleum Gas (LPG) Ultra Low Emissions Vehicle (ULEV)
IMPCO Technologies; Oct. 28, 1998; 6p; In English
Report No.(s): DE00-006575; NREL/SR-540-25155; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

This report describes the last in a series of three projects designed to develop a commercially competitive LPG light-duty passenger car that meets California ULEV standards and corporate average fuel economy (CAFE) energy efficiency guidelines for such a vehicle. In this project, IMPCO upgraded the vehicle's LPG vapor fuel injection system and performed emissions testing. The vehicle met the 1998 ULEV standards successfully, demonstrating the feasibility of meeting ULEV standards with a dedicated LPG vehicle.
NTIS
Automobiles; Crude Oil; Liquefied Gases; Exhaust Emission

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.

20000014441 New Mexico State Univ., Center for Space Telemetering and Telecommunications, Las Cruces, NM USA
Spread-Spectrum Carrier Estimation With Unknown Doppler Shift
DeLeon, Phillip L., New Mexico State Univ., USA; Scaife, Bradley J., Motorola, Inc., USA; [1998]; 5p; In English
Contract(s)/Grant(s): NAG5-7520; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We present a method for the frequency estimation of a BPSK modulated, spread-spectrum carrier with unknown Doppler shift. The approach relies on a classic periodogram in conjunction with a spectral matched filter. Simulation results indicate accurate carrier estimation with processing gains near 40. A DSP-based prototype has been implemented for real-time carrier estimation for use in New Mexico State University's proposal for NASA's Demand Assignment Multiple Access service.
Author
Binary Phase Shift Keying; Spread Spectrum Transmission; Doppler Effect

20000014443 Defence Research Establishment Ottawa, Ottawa, Ontario Canada
DREO Secure Video Conferencing and High Speed Data Encryption Tests for Inmarsat-B Satellite Terminals
Lambert, James D.; Oct. 1999; 51p; In English
Report No.(s): AD-A371256; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The aim of this report is to describe the results of a series of tests performed between 1996 and 1999 using Inmarsat-B satellite terminals. These tests were designed to evaluate the use of Commercial-Off-The-Shelf (COTS) equipment in demonstrating low-rate, secure video conferencing, multiplexed voice and data circuits, and LAN extension services via the Inmarsat-B 64 kb/s High Speed Data (HSD) service. Successful demonstrations of both secure point-to-point, and secure remote-to-Defence Video Conferencing Network (DVCN) were conducted,
DTIC
Inmarsat Satellites; Earth Terminals; Satellite Ground Support; Video Communication; Data Transmission

20000014457 Helsinki Univ. of Technology, Electromagnetics Lab., Espoo, Finland
Assessment of Diversity Techniques in a Microcellular Radio Propagation Channel
Lempiainen, Jukka J. A., Helsinki Univ. of Technology, Finland; June 1999; 106p; In English
Report No.(s): PB2000-100777; Rept-301; ISBN-951-22-4596-5; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy
The aim of this study was to evaluate the performances ot different diversity schemes at the base station receiving end in a microcellular radio propagation channel in narrowband mobile networks as Global System for Mobile Communication (GSM). The particular motivation was to determine a base station antenna array configuration of minimum spatial size to provide the best diversity gain in line-of-sight (LOS) and non-line-of-sight (NLOS) situations. Computed simulations and measurement campaigns were performed at 900 MHz and 1800 MHz frequency bands applying different diversity schemes was evaluated based on signal cross-correlation, signal mean level and diversity gain values. First, different space and polarization diversity schemes were studied to show the performance of these techniques in mobile networks. Next, two different beam diversity schemes were evaluated by using only one physical antenna array location. The obtained results showed that significant improvement at the base station receiving end in a microcellular radio.propagation channel can be achieved by using different diversity schemes. Finally, the optimal diversity scheme can be chosen based on information from the system, the maximum spatial size of the antenna array configuration and the radio propagation path (LOS/NLOS).
Author (NTIS)
Radio Transmission; Communication Networks; Pulse Communication; Radio Communication; Land Mobile Satellite Service

20000015356 Naval Postgraduate School, Monterey, CA USA
Maximum-Likelihood Estimators for the Time and Frequency Differences of Arrival of Cyclostationary Digital Communications Signals
Streight, David A.; Jun. 1999; 163p; In English
Report No.(s): AD-A371749; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
Advanced techniques have been employed for decades in the location of emitted communications signals. The use of cyclostationary maximum-likelihood estimators (MLE) applied to time different of arrival (TDOA) and frequency difference of arrival (FDOA) techniques for target emitter location is a newly developed approach. This dissertation provides an introduction to traditional TDOA and FDOA methods and the underlying cyclostationary theory of pseudo-random signals. A survey of current cyclostationary TDOA and FDOA methods, the description of new maximum likelihood estimators (MLEs) and descriptions of Monte Carlo simulations follow this. by comparing performance results to those of the Complex Ambiguity Function (CAF), it is shown that the new MLE(s) outperform the CAF in nearly all cases. Also, by comparison to the Cramer-Rao lower bound, the new MLE(s) provide a hint of the ultimate power of cyclostationary techniques over stationary techniques, exceeding this stationary theoretical lower bound on performance in many cases. Finally, the new MLE(s) perform comparably in the

measurement of TDOA to those cyclostationary algorithms previously derived, when adjustments are made for the different signal environments used in the heritage work.
DTIC
Maximum Likelihood Estimates; Frequencies; Pulse Communication

20000015357 Naval Undersea Warfare Center, Newport, RI USA
Seasonal Performance of a High-Frequency/Automatic Link Establishment (HF/ALE) Radio Network Operating at Mid to High Latitudes in the Southern Hemisphere, Volume 2, Data Plots ***Final Report***
Gilles, Patrick E.; Katan, Joseph R.; Pellowski, Robert J.; May 07, 1999; 161p; In English; Prepared in collaboration with Tele-Technologies Inc.
Report No.(s): AD-A371751; NUWC-NPT-TR-11106-VOL-2; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
A high-frequency (HF)/automatic link establishment network was established between four sites located in Christ church in New Zealand, Salisbury in Australia, and McMurdo and Davis Station in Antarctica. The experiment was a joint effort between the US Naval Undersea Warfare Center and the Australian Defence Science and Technology Organization. Hourly link quality analysis data were collected between September 1992 and November 1994. The primary goal was to study the potential benefits of introducing an automatic frequency management system into the daily operations of the HF communications links involving mid- to high-latitude propagation paths. Ten frequencies between 5 and 26 MHz were evaluated and the data were plotted versus time-of-day and season and compared to predicted results. This report is presented in two volumes. Volume 1 (TR 11,106-1) contains the background, site descriptions, equipment and experiment design information, and conclusions. Volume 2 (TR 11,106-2) contains the supporting data plots.
DTIC
Management Systems; Research and Development; Communication Networks

20000015400 Naval Postgraduate School, Monterey, CA USA
Feature Extraction of Intra-Pulse Modulated Radar Signals Using Time-Frequency Analysis
Moraitakis, Ioannis; Sep. 1999; 117p; In English
Report No.(s): AD-A371390; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This thesis applies time-frequency transformations to radar signals. Specifically, it considers the feasibility of applying time-frequency transformations to extract the intra-pulse modulation parameters of radar signals. In this work, we consider radar signals with analog pulse compression; specifically linear or hyperbolic intra-pulse modulation. Several time-frequency transformations are investigated to identify which one gives the most accurate image representation for signals in noisy environments. Next, image processing techniques are applied in conjunction with an adaptive curve fitting method, for the hyperbolic modulation scheme, to extract the parameters of the frequency equation. Results show that for the linear chip case the frequency equation can be estimated with small error down to SNR equal to -10dB. The proposed method for the hyperbolic chirp modulation is less immune to noise degradation and it can be used down to SNR level equal to 2dB.
DTIC
Pulse Compression; Radar Signatures; Pattern Recognition; Signal Processing; Signal to Noise Ratios

20000015410 National Defence Research Establishment, Dept. of Command and Control Warfare Technology, Linkoeping, Sweden
Distributed Routing in Mobile Tactical Radio Networks ***Distribuerad Routing i Mobila Taktiska Radionaet***
Skoeld, M.; Apr. 1999; 60p; In Swedish
Report No.(s): PB2000-101434; FOA-R-99-01118-504-SE; No Copyright; Avail: National Technical Information Service (NTIS), Hardcopy
In mobile multi-hop wireless networks, the topology can change rapidly. For robustness towards topology changes, traffic management is distributed to all nodes. The routing algorithm chooses the communication path in the network. This report investigates three distributed routing algorithms, flooding, Distributed Bellman-Ford (DBF) and Lightweight Mobile Routing (LMR). These algorithms have been implemented and evaluated. The algorithms have been simulated for seven networks with different degrees of mobility. The evaluation shows that for the tested networks, the meak packet delay is less in LMR than in flooding and DBF, and furthermore LMR requires less administrative traffic. Administrative traffic contains the information about which neighbor a node should send a message to.
NTIS
Mobility; Radio Transmission; Mobile Communication Systems; Wireless Communication

20000017927 Defence Research Establishment Ottawa, Ottawa, Ontario Canada
Evaluation of Iridium Paging Services For Military Applications
Tom, Caroline; Wagner, Lyle C.; Aug. 1999; 28p; In English
Report No.(s): AD-A371293; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Iridium is the first satellite-based personal communications system offering global service via an interconnected constellation of low earth orbit (LEO) satellites communicating directly with handheld terminals. The total constellation of satellites was launched over a 12-month period ending May 1998. Voice service commenced in November 1998 followed by paging services in March 1999. This Technical Memorandum describes an evaluation of the Iridium paging service carried out by the Military Satellite Communications (MSC) Group at Defence Research Establishment Ottawa (DREO) during the period March to June 1999. Paging tests were performed under two principle scenarios: stationary and inflight paging. Performance parameters observed include delivery time and message error performance.
DTIC
Evaluation; Iridium; Military Technology; Voice Data Processing

20000017936 Defence Research Establishment Ottawa, Ottawa, Ontario Canada
An Evaluation of the Watson-Watt and Butler Matrix Approaches For Direction Finding
Read, William J.; Sep. 1999; 70p; In English
Contract(s)/Grant(s): 5BB24
Report No.(s): AD-A371289; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In this report, an evaluation of the Watson-Watt and Butler matrix approaches for tactical wideband radio direction finding applications is described. This evaluation was carried out using theoretical derivations and computer simulations, concentrating on the effects of various error mechanisms including internal noise, terrestrial and isotropic noise, cochannel interference, and multipath. A maximum likelihood (ML) approach was also derived and evaluated for comparative purposes to determine the accuracy trade-off between using an N-channel approach versus the three channel Watson-Watt approach and the two channel Butler matrix approach. The results indicate that the Watson-Watt approach is superior to the Butler matrix approach for current applications. In the future, this choice may need to be reassessed as lower cost receivers and faster processing equipment make more sophisticated approaches such as ML attractive alternatives.
DTIC
Direction Finding; Radio Direction Finders; Computerized Simulation; Matrices (Mathematics)

20000017944 General Accounting Office, Washington, DC USA
Telecommunications: State and Federal Actions to Curb Slammimg and Cramming
Jul. 1999; 46p; In English
Report No.(s): PB99-166977; GAO/RCED-99-193; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

You asked us to describe the (1) number of complaints about slamming and cramming received by state and federal authorities, (2) types of protections implemented by state and federal authorities to increase consumers ability to protect themselves against slamming and cramming, and (3) state and federal enforcement actions taken against slamming and cramming violations since 1996, including the names of companies or individuals most frequently subject to such actions. to address these issues, we surveyed the public utilities commissions of all 50 states and the District of Columbia and assisted the National Association of Attorneys General in surveying each state's office of attorney general and the District's corporate counsel. In addition, we met with FCC and FTC officials to gather information on the enforcement actions they have taken against companies engaged in slamming and cramming. We discussed recent regulatory initiatives by FCC and FTC to combat these abuses and improve their ability to take enforcement action.
NTIS
Telecommunication; Telephones

20000017968 Swedish Inst. of Space Physics, MRI Atmospheric Research Programme, Kiruna, Sweden
The Esrange MST Radar: A Brief Introduction and Procedure for Range Validation Using Balloons
Chilson, Phillip B., Swedish Inst. of Space Physics, Sweden; Kirkwood, Sheila, Swedish Inst. of Space Physics, Sweden; Nilsson, Annika, Umea Univ., Sweden; Radio Science; Mar.-Apr. 1999; ISSN 0048-6604; Volume 34, No. 2, pp. 427-436; In English
Report No.(s): Paper-1999RS900023; Copyright; Avail: Issuing Activity, Hardcopy

The Esrange VHF radar (ESRAD) is a relatively new mesosphere-stratosphere-troposphere (MST) class radar located in northern Sweden (67.88 deg N, 21.10 deg E), about 30 km east of Kiruna. The radar operates continuously and has already been included in several campaigns in which multiple profiling instruments have been used, for example, lidars, radiosondes, and

scientific balloons. to intercompare the different measurements, It is essential to have precise height estimates. In this paper we begin by presenting a short technical overview of the radar. Then we describe a radar validation conducted in 1997 during a period when numerous scientific balloons were launched from Esrange. All of these balloons were tracked using one or more of the following techniques: Omega navigational system, Global Positioning System (GPS), or the Esrange C-band tracking radar (ESR). A number of these balloons passed close enough to the ESRAD beam that they could be detected by the MST radar. This unique data set has been used to check the range estimation of ESRAD. Furthermore, the data have been used to make a rough check of the geometry of the formed beam.
Author
Optical Radar; Radiosondes; Meteorological Radar; Estimates

20000017992 Space and Naval Warfare Systems Center, San Diego, CA USA
Relative Ladar Performance in Littoral Environments: The Case for Mid-IR Coherent Laser Radars
Hanson, Frank, Space and Naval Warfare Systems Center, USA; Schimitschek, Erhard, Space and Naval Warfare Systems Center, USA; Proceedings: IRIS Active Systems; February 1999; Volume 1, pp. 59-76; In English
Report No.(s): AD-A369545; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
Laser radars, like other electro-optic sensors being used in the terrestrial environment, can be strongly affected by atmospheric conditions. In this paper we calculate a statistical distribution of coherent laser radar performance based on an extensive set of observed weather conditions for various littoral locations at laser wavelengths from 1 to 10 micron. It will be shown that the Mid-IR wavelength region around 3.8 micron gives overall the best performance, being less affected,by aerosol scattering compared to the Near-IR and ;also less affected by water vapor absorption compared to the Long-IR.
Author
Aerosols; Coherent Radar; Infrared Radiation; Laser Range Finders; Near Infrared Radiation; Atmospheric Scattering; Target Recognition

20000019595 Naval Undersea Warfare Center, Newport, RI USA
Seasonal Performance of a High-Frequency/Automatic Link Establishment (HF/ALE) Radio Network Operating at Mid to High Latitudes in the Southern Hemisphere, Volume 1 ***Final Report***
Gilles, Patrick E.; Katan, Joseph R.; Pellowski, Robert J.; May 07, 1999; 229p; In English; Prepared in collaboration with Tele-Technologies Inc.
Report No.(s): AD-A371652; NUWC-NPT-TR-11106-VOL-1; No Copyright; Avail: CASI; A03, Microfiche; A11, Hardcopy
A high-frequency (HF)/automatic link establishment network was established between four sites located in Christchurch in New Zealand, Salisbury in Australia, and McMurdo and Davis Station in Antarctica. The experiment was a joint effort between the US Naval Undersea Warfare Center and the Australian Defence Science and Technology Organization. Hourly link quality analysis data were collected between September 1992 and November 1994. The primary goal was to study the potential benefits of introducing an automatic frequency management system into the daily operations of the HF communications links involving mid- to high-latitude propagation paths. Ten frequencies between 5 and 26 MHz were evaluated and the data were plotted versus time-of-day and season and compared to predicted results. This report is in presented in two volumes. Volume I (TR 11,106-1) contains the background, site descriptions, equipment and experiment design information, and conclusions. Volume II (TR 11,106-2) contains the supporting data plots.
DTIC
Research and Development; Communication Networks; Management Systems; Links; Radio Transmission

20000019597 University of Central Florida, Electrical and Computer Engineering Dept., Orlando, FL USA
Wireless Communication Spectrum Guidelines for ITS ***Final Report***
Dec. 01, 1999; 140p; In English
Contract(s)/Grant(s): UCF-16-22-785
Report No.(s): PB2000-102427; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy
In this research presentation, the Hata-Okumura model is used as the basis of deriving a suitable RF propagation model for the spread spectrum environment. Spread spectrum results in efficient spectrum use, and today the FCC designated frequency band of 2400-2483.5 MHz is widely used in digital cellular radios, wireless local area networks, personal communication networks, traffic control systems and global positioning systems to name a few. Spread spectrum signals are basically wide-band

noise-like signals. The final report highlights the direct sequence spread spectrum system, which has a few advantages, over the frequency hopping type.
NTIS
Wireless Communication; Spread Spectrum Transmission; Air Traffic Control; Telecommunication

20000019600 Mitretek Systems, Inc., McLean, VA USA
Application of Various Digital Subscriber Line (xDSL) Technologies to ITS: Traffic Video Laboratory Assessments
Biesecker, K., Mitretek Systems, Inc., USA; Charleston, G., Mitretek Systems, Inc., USA; Feb. 12, 1999; 138p; In English
Report No.(s): PB2000-102366; MP-1999-27; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

Various digital subscriber line (xDSL) technologies are methods, used to implement high-speed data services on a twisted pair (wire) communications medium. They are also candidates for rapidly deploying Intelligent Transportation Systems (ITS) services over existing communications infrastructure. However, as emerging technologies, they are rapidly evolving and remain largely unknown to the transportation industry, and proof-of-concept studies are needed to establish their application within ITS. As part of a Federal Highway Administration (FHWA) task, Mitretek Systems is conducting such studies. Commercially available xDSL products and services exist, and systems are in place to support the more popular residential applications, including Internet access and video on-demand. However, ITS applications such as freeway surveillance video are untested. This paper documents a Mitretek concept study devised to establish, demonstrate, and evaluate the use of xDSL technologies within ITS, particularly traffic video applications (e.g., traffic management, incident detection).
NTIS
Telecommunication; Highways; Traffic; Surveillance

20000019601 Mitretek Systems, Inc., McLean, VA USA
Application of Various Digital Subscriber Line (xDSL) Technologies to ITS: Traffic Video Field Assessments
Biesecker, K., Mitretek Systems, Inc., USA; Charleston, G., Mitretek Systems, Inc., USA; Jun. 1999; 98p; In English
Report No.(s): PB2000-102365; MP-1999-50; No Copyright; Avail: CASI; A02, Microfiche; A05, Hardcopy

Various digital subscriber line (xDSL) technologies are those methods used to implement high-speed data services (e.g., 2 Mbps Frame Relay) on a twisted pair (wire) communications medium. They are also considered strong candidates for rapidly deploying Intelligent Transportation Systems (ITS) services over existing communications infrastructure. ITS applications such as freeway surveillance video were untested. The paper documents the final phase of a Federal Highway Administration (FHWA) study to assess the application of xDSL technologies to ITS, particularly their use for traffic video. This is an addendum to 'The Application of Various Digital Subscriber Line (xDSL) Technologies to ITS: Traffic Video Laboratory Assessments'--an earlier report that provides a general understanding of the various DSL technologies and describes the concept of xDSL-based traffic video. This supplement documents the field testing of an xDSL-based traffic video prototype that was built during the laboratory studies. In addition to validating laboratory findings, field tests were used to demonstrate the prototype's capabilities in an operational environment.
NTIS
Telecommunication; Field Tests; Prototypes; Traffic

20000019606 Helsinki Univ. of Technology, Electromagnetics Lab., Espoo, Finland
Extended Electromagnetic Continuity Condition and Generalized Huygens' Principle
Lindell, I. V., Helsinki Univ. of Technology, Finland; Tretyakov, S. A., Helsinki Univ. of Technology, Finland; Nikoskinen, K. I., Helsinki Univ. of Technology, Finland; June 1999; ISSN 1456-632X; 16p; In English
Report No.(s): PB2000-100824; Rept-300; ISBN 951-22-4599-X; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

The electromagnetic continuity condition is extended from the classical condition on an interface between two media to a more general one relating sources and fields in a region between two regions of arbitrary media. The condition allows one to extend the classical huygens' principle to involve equivalent sources in a spatial region volume or on multiple surface. The condition is applicable to extending surface integral equations from a surface to multiple surfaces or volume regions. Also, the transparent absorbing boundary (TAB) condition can be interpreted in terms of the extended Huygens' principle.
NTIS
Electromagnetic Properties; Continuity; Boundary Conditions; Huygens Principle

20000019608 Helsinki Univ. of Technology, Electromagnetics Lab., Espoo, Finland

Electromagnetic Boundary Conditions in Differential-Form Formalism

Lindell, I. V., Helsinki Univ. of Technology, Finland; Jancewicz, B., Helsinki Univ. of Technology, Finland; May 1999; ISSN 1456-632X; 14p; In English

Report No.(s): PB2000-100778; Rept-297; ISBN 951-22-4533-7; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

A simple way of deriving the electromagnetic boundary conditions in the differential-form formalism is outlined. The derivation is based on glueing together two independent electromagnetic source-field systems each existing in an arbitrary electromagnetic environment. The combined electromagnetic source-field system contains a surface separating regions of the two original systems and media. It is shown that, in general, additional sources at the surface are needed for the new system to satisfy the Maxwell equations. This requirement is seen to create a set of boundary conditions at the surface. As a by-product, Huygens' can be formulated in differential form formalism.

NTIS

Electromagnetic Fields; Boundary Conditions; Formalism

20000019616 Oregon State Univ., Coll. of Oceanic and Atmospheric Sciences, Corvallis, OR USA

Flux Sampling Errors for Aircraft and Towers

Mahrt, Larry, Oregon State Univ., USA; Journal of Atmospheric and Oceanic Technology; 1998; Volume 15, pp. 416-429; In English

Contract(s)/Grant(s): DAAH04-96-1-0037; NAG5-2300; NSF ATM-93-10576

Report No.(s): AD-A370038; ARO-34983.6-EV; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

Various errors and influences leading to differences between tower- and aircraft-measured fluxes are surveyed. This survey is motivated by reports in the literature that aircraft fluxes are sometimes smaller than tower-measured fluxes. Both tower and aircraft flux errors are larger with surface heterogeneity due to several independent effects. Surface heterogeneity may cause tower flux errors to increase with decreasing wind speed. Techniques to assess flux sampling error are reviewed. Such error estimates suffer various degrees of inapplicability in real geophysical time series due to nonstationarity of tower time series (or inhomogeneity of aircraft data). A new measure for nonstationarity is developed that eliminates assumptions on the form of the nonstationarity inherent in previous methods. When this nonstationarity measure becomes large, the surface energy imbalance increases sharply. Finally, strategies for obtaining adequate flux sampling using repeated aircraft passes and grid patterns are outlined.

Author

Sampling; Errors; Airport Towers

20000019639 Naval Research Lab., Center for Environmental Acoustics, Stennis Space Center, MS USA

Coherence Estimation for High-Frequency Narrowband CW Pulsed Signals in Shallow Water

Meredith, Roger W., Naval Research Lab., USA; Nagle, Samuel M., Office of Naval Research, USA; Journal of Acoustical Society of America; August 1999; ISSN 0001-4966; Volume 106, No. 2, pp. 828-836; In English

Report No.(s): AD-A368465; NRL/JA/7174-97-0050; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

Signal coherence is an important environmental predictor for sonar performance and is often difficult to estimate. This paper examines different methods for estimating signal coherence from data not amenable to coherence estimation. Methods are compared using narrowband, high-frequency, short pulse length continuous wave signals (cw) that typify those used by mine-hunting sonars in complex shallow-water environments in which the spectral frequency resolution is poor using classical overlapping segments and Fourier techniques. Alternate approaches for the spectral and coherence estimation were the autoregressive parametric based approach, harmonic wavelet approach, and concatenation. These methods provide a statistic similar to coherence that is shown to be useful for specialized data. Low model orders in the parametric method yield results that are difficult to interpret. The wavelet approach is more suited for signals whose frequency spans several wavelet levels. Concatenation via narrowband spectral averaging Improves spectral resolution but at the expense of pulse train temporal resolution. Generally, these other methods perform no better than classical Fourier-based techniques; however. they can be useful in a limited sense as a relative measure of the "spectrum sameness" between outputs of a single system.

Author

Continuous Radiation; Estimating; Narrowband; Shallow Water; Coherent Radiation; Frequency Response

20000019659 General Accounting Office, Office of the Comptroller General, Washington, DC USA

Testimony Before the Committee on Appropriations, US Senate. Year 2000 Computing Challenge: Readiness Improving, but Critical Risks Remain

Jan. 20, 1999; 26p; In English

Report No.(s): PB2000-101816; GAO/T-AIMD-99-49; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The federal government--with it widespread dependence on large-scale, complex computer systems to deliver vital public services and carry out its massive operations--faces an especially enormous and difficult task. Unless adequately confronted, year 2000--or Y2K--computing problems could lead to serious disruptions in key federal operations, ranging from national defense to benefits payments to air traffic management. At this juncture, however, a comprehensive picture of the nation's readiness is lacking. A great deal more needs to be done--both domestically and internationally--to effectively determine readiness and prepare necessary contingency plans. Such actions are imperative to ensure that technology-dependent services continue to operate reliably after the turn of the century, with minimal disruption.

NTIS

Congressional Reports; Complex Systems; Computer Programming; Computer Networks; Systems Management; Software Engineering

20000020762 Naval Postgraduate School, Monterey, CA USA

Implementing a Low-Complexity, Adaptive, Layered Video Coder for Video Teleconferencing

Skretkowicz, Steven J.; Sep. 1999; 125p; In English

Report No.(s): AD-A371067; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Real-time interactive video applications, such as video teleconferencing, present difficult challenges to network designers due to strict quality of service constraints and the limitations of traditional video compression schemes. These limitations reveal themselves notably in two areas: poor error robustness and a lack of flexibility when dealing with multicast scenarios over heterogeneous networks. A more promising approach that improves error robustness while also offering a solution to the network heterogeneity problem is to employ a layered video codec. This thesis presents the implementation of a new layered video coder scheme. Block updating coupled with an aging algorithm is used in this scheme to select macroblocks for transmission. Block updating selects macroblocks that have changed due to scene motion, and the aging algorithm ensures that an entire frame is transmitted within a set time interval. Layering is accomplished through application of the fast Haar transform and/or the discrete cosine transform. Layer assignments are made by grouping bands of coefficients with similar variances. Quantization and encoding for motion video employs both an industry standard and uniform quantization with a custom variable length coding table. For static slides, uniform quantization and a second custom variable length coding table are employed. Rate control is accomplished via the reduction of a four-dimensional operational distortion surface to a one-dimensional optimal curve implemented as a simple table lookup of quantizers.

DTIC

Teleconferencing; Video Data; Signal Encoding; Telecommunication; Network Analysis; Real Time Operation

20000020767 Northwestern Univ., Dept. of Electrical Engineering and Computer Science, Evanston, IL USA

Linear Interference Suppression and Pulse Optimization for DS-CDMA ***Final Report, 15 Aug. 1996 - 24 Aug. 1999***

Honig, Michael L.; Nov. 12, 1999; 13p; In English

Contract(s)/Grant(s): DAAH04-96-1-0378

Report No.(s): AD-A371495; ARO-35025.7-EL; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This project is concerned with the applicability of adaptive linear interference suppression for DS-CDMA in a peer-to-peer network. This technique is robust with respect to extreme near-far power variations. The following topics have been studied: (1) performance in the presence of time- and frequency-selective fading, (2) reduced-rank methods for faster convergence and tracking, (3) adaptive transmitter preprocessing for interference avoidance, (4) combined coding and interference suppression, and (5) performance in the presence of mixed rate traffic. Overall, our results indicate that adaptive linear interference suppression can be made robust with respect to time-varying channels and interference. Algorithmic enhancements which improve upon the performance in a dynamically changing environment have been proposed and evaluated.

DTIC

Code Division Multiple Access; Wireless Communication; Retarding

20000020782 McKesson HBOC BioServices, Brooks AFB, TX USA
A Mathematical Model of a Gigahertz Transverse Electromagnetic Cell, 1 ***Interim Report, Feb. 1998 - Jan. 1999***
Samn, Sherwood; Mathur, Satnam; May 1999; 23p; In English
Contract(s)/Grant(s): Proj-7757
Report No.(s): AD-A371646; AFRL-HE-BR-TR-1999-0219; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

A mathematical model for transverse electromagnetic (TEM) cell has been constructed. The model estimates the electric field inside rectangular or flared TEM cells driven by a wideband electromagnetic current pulse. The finite difference time domain (FDTD) approach is used.

DTIC
Electromagnetic Pulses; Mathematical Models

20000020895 National Telecommunications and Information Administration, Inst. for Telecommunication Sciences, Washington, DC USA
Radio Link Performance Prediction via Software Simulation
Quincy, E. A.; Achatz, R. J.; Cotton, M. G.; Roadifer, M. P.; Ratzloff, J. M.; Oct. 1999; 80p; In English
Report No.(s): PB2000-101858; NTIA-00-371; No Copyright; Avail: National Technical Information Service (NTIS)

The subjective quality of speech and image information, transmitted over a high frequency radio link impaired with varying levels of interference, has been evaluated using software simulation. The high frequency radio link was also degraded by frequency-selective multipath and non-Gaussian noise. During radio link signal simulation, an error sequence, determined from a comparison of transmitted and received bits, was collected. Next, digitized speech and image information was distorted by the error sequence. Last, the quality of the distorted speech and image information was subjectively evaluated. This process was repeated for a large number of interference conditions. The same process can be used to show how multipath and non-Gaussian noise affects speech and image quality.

NTIS
Radio Signals; Computerized Simulation; Performance Prediction

20000020931 National Inst. of Standards and Technology, Gaithersburg, MD USA
North American ISDN Users' Forum (NIUF): Minutes Publication
Sep. 24, 1999; 288p; In English; 36th, 22-24 Jun. 1999, Montreal, Canada
Report No.(s): PB2000-101774; No Copyright; Avail: National Technical Information Service (NTIS)

The National Institute of Standards and Technology (NIST), along with co-host EICON Technologies, sponsored the thirty-sixth meeting of the NIUF on June 22-24, 1999. Approximately 40 users, implementors and service providers for ISDN technology attended the forum, which has held at the Ritz-Carlton in Montreal, Canada. Educational sessions are held on a variety of ISDN topics including: History of the NIUF; Current State of ISDN; ISDN Testing Overview; network Implementation/Maintenance; Alternative Technologies: ADSL & ISDN, Voice over Packet, Local Multipoint Distribution Service; ISDN Applications: Teleworking, ISDN Centrex Solutions; Product Vendor Presentations: 3Com, EICON, Lucent, Nortel, Siemens, Tone Commander, Adtran; Access Technology Forum (formerly Vendors ISDN Association); and ISDN Summit Update.

NTIS
Education; Maintenance; Telecommunication; Communication Networks

20000020988 Villanova Univ., Dept. of Electrical and Computer Engineering, PA USA
Blind Time-Frequency Analysis for Source Discrimination in Multisensor Array Processing, ***1 Oct. 1998 - 30 Sep. 1999***
Amin, Moeness G.; Oct. 1999; 213p; In English
Contract(s)/Grant(s): N00014-98-1-0176
Report No.(s): AD-A368941; No Copyright; Avail: CASI; A03, Microfiche; A10, Hardcopy

The research efforts over 1998/1999 phase focused on nonstationary signals and the applications of time-frequency signal representations to multi-antenna receivers. We have clearly demonstrated, through analysis and simulations, the offerings of time-frequency distributions in solving key problems in sensor array processing, including direction finding, source discrimination, and blind signal recovery. Significant progress has been made in understanding how the time-frequency signatures of the signals impinging on an array of sensors can be utilized to improve array performance. The major contributions over the fiscal year ending September 30th 1999 are: 1) Regress analysis of eignestructure methods employing time-frequency distributions which has demonstrated their superiority over those used in conventional high resolution methods based on data covariance matrices, 2) Evaluating the performance of the spatial time-frequency distributions in low SNR and coherent signal

environments, and introducing maximum likelihood techniques based on the sources' time-frequency signatures, 3) Identifying the role of time-frequency cross-terms in spatial signal processing, and presenting a prudent way to use those terms for enhanced performance, 4) Providing a novel approach for incorporating the revolutionary power spectra into source discrimination and angle of arrival estimation, and examining their advantages over quadratic time-frequency distributions. We have also made significant advances in the solutions of the problem of suppressing nonstationary jammers in broadband signal environment, using both projection techniques and frequency diversity methods. In the following, we summarize the above key contributions, leaving the details to the appendix, which also includes other contributions we have made from the research funding of this project.
DTIC
Time Signals; Frequency Distribution; Multisensor Applications; Signal Processing; Antenna Arrays

20000021000 Pennsylvania State Univ., Center for Multivariate Analysis, University Park, PA USA
On the Determination of the Number of Signals and its Performance Analysis in Presence of White Noise
Kundu, Debasis, Pennsylvania State Univ., USA; Jul. 21, 1999; 11p; In English
Contract(s)/Grant(s): DAAH04-96-1-0082
Report No.(s): AD-A370891; TR-99-12; ARO-35518.57-MA; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

In signal processing, high resolution signal parameter estimation is a significant problem. In particular the estimation of the direction of the narrow band signals emitted by multiple sources received wide applications recently in signal processing literature. Quite a number of papers appeared in the last twenty five years regarding the estimation of the parameters of the direction of arrival of signals, but not that much attention has been given in estimating the number of signals. In this paper we develop a method using penalty function technique. But instead of using any fixed penalty function like AIC or MDL, a class of penalty functions satisfying some special properties have been used. We prove that any penalty function from the particular class will produce consistent estimates under the assumptions that the error random variables are independent and identical distributed with mean zero and finite variance. We also obtain the probabilities of wrong detection for any particular penalty function and estimate it using the matrix perturbation technique. It gives some idea to choose the proper penalty function for any particular model. Simulations are performed to verify the usefulness of the analysis and to compare our method with the existing ones.
DTIC
Signal Processing; White Noise; Random Variables; Penalty Function; Random Signals; Probability Theory

20000021027 Research Inst. of National Defence, Dept. of Command and Control Warfare Technology, Linkoeping, Sweden
Novel Stealth Radio Concept: Based on a Direct Sequence System and Using Filtered Spreading Codes
Borgstroem, A.; Nov. 1998; ISSN 1104-9154; 58p; In English
Report No.(s): PB99-172512; FOA-R-00895-504-SE; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

At the Department of Communications Systems, a research project on stealth properties of radio signals has been going on for several years. As part of this project, a novel radio concept was invented, a variant on the well known direct sequence technique, and it was expected to improve the stealth properties. The authors applied for a patent on this system in 1995 in several countries and it is now sold to L.M. Ericsson AB. This report summarizes many of the results that have been derived in this project since 1995. The authors present the new spreading code and its properties together with descriptions of two possible applications. Both these applications are shown to have good stealth properties compared to a normal direct sequence system. This comparison is done by simulations in MATLAB and shown in various plots and is evaluated for some usual hostile detectors. Also, some other properties of these systems are discussed. Furthermore, two other similar systems are presented, one developed in the author's project as a variant on the patented system and one developed in South Africa with a slightly different approach.
NTIS
Radio Communication; Telecommunication

33
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.

20000014446 Michigan Univ., Ann Arbor, MI USA
Technologies for Low-Power VLSI Design ***Final Report***
Papaefthymiou, Marios C.; Oct. 20, 1999; 10p; In English
Contract(s)/Grant(s): DAAH04-95-1-0281; DAAG55-97-1-0395
Report No.(s): AD-A371371; ARO-37362.4-EL-YIP; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This project investigated novel design methodologies for low energy VLSI circuits and systems. It focused on energy recovering circuit architectures, a promising alternative to conventional digital CMOS circuits for low energy operation. It also explored technologies for designing low energy conventional CMOS circuits. The main contribution of our research was the discovery of TSEL, the first true single phase energy recovering circuit family. TSEL achieves very efficient operation in comparison with conventional CMOS and other energy recovering circuits. Due to its extremely simple clocking requirements. TSEL is ideal for high speed design. Moreover, TSEL gates are straightforward to cascade and are thus particularly suitable for the design of energy efficient data path components with regular structures. In the course of this project, we designed, developed, and evaluated layouts of several arithmetic units in TSEL, CMOS and several other energy recovering logic families. Our designs included 8-bit energy recovering multipliers, 8-bit carry look ahead adders, and an 8-point/4-bit Hadamard Transform module.
DTIC
Very Large Scale Integration; Digital Electronics; Integrated Circuits; Arithmetic and Logic Units

20000014447 Materials Research, Inc., Beavercreek, OH USA
Inkjet Printing of Flexible Circuits on Polymer Substrate ***Final Report, 1 Sep. 1998 - 31 Aug. 1999***
Chu, Chung-tse; Nov. 18, 1999; 27p; In English
Contract(s)/Grant(s): F49620-98-C-0078
Report No.(s): AD-A371393; MRI-005Z; AFRL-SR-BL-TR-99-0285; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flexible printed circuits have a wide range of applications in consumer electronics, computers, automobiles, and space and aerospace vehicles. In this Small Business Technology Transfer (STTR) Phase 1 program, Materials Research Institute (MRI) and University of Dayton Research Institute (UDRI) demonstrated the feasibility of a new processing scheme leading toward the fabrication of high performance, low cost flexible circuits with computer aided design tools using the inkjet printing technology. Silver metal precursor solutions were studied for their viscosity and printability. Printed conductor patterns were evaluated on three commercially available polymer substrate materials. Research emphasis was focused on improving adhesion between the reduced conductor metal and the polymer substrate. Ag conductor patterns obtained from this processing scheme exhibited excellent electrical conductivity, mechanical integrity, and adhesion. This processing scheme is simple yet versatile. It can be readily extended to build multiple layer circuits as well as circuits on a contour surface.
DTIC
Computer Aided Design; Integrated Circuits; Printed Circuits

20000014449 North Carolina State Univ., Dept. of Electrical and Computer Engineering, Raleigh, NC USA
Novel SiC High Power IC Technology ***Annual Report, 1 Jan. - 31 Dec. 1999***
Baliga, B. J.; Mehrotra, Pronita; Venkateswaran, Aravind; Dec. 31, 1999; 17p; In English
Contract(s)/Grant(s): N00014-98-1-0534
Report No.(s): AD-A371832; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of this project is to develop a silicon carbide technology which is similar to that used today for manufacturing silicon power ICs. Silicon high voltage devices are integrated together with CMOS circuits by using the RESURF concept to create lateral structures with high voltage handling capability. In the case of silicon, the RESURF region must have an optimum charge of about 1 x 10(exp 12)/sq cm. Due to the higher breakdown electric field strength of SiC, it can be expected that the optimum dose for SiC devices will also be larger leading to lower on resistances. Our analysis performed using two-dimensional numerical simulations has demonstrated that the optimum RESURF dose for SiC is an order of magnitude greater than that for silicon. We have also found that it is better to use silicon nitride instead of silicon dioxide as the field dielectric to avoid high electric fields. In order to confirm our analysis, we have defined a 11 mask planar process for SiC based upon ion implantation to form all the

device structural regions. We have completed the design of a mask set with 47 structures consisting of high voltage rectifiers and power MOSFETs with both inversion channels and accumulation channels together with CMOS transistors. The fabrication of devices has been stating using 4 wafers procured from CREE Research Inc. with 10 micron thick P-type layers grown on P+ substrates.
DTIC
Silicon Carbides; CMOS

20000014451 New Mexico State Univ., Klipsch School of Electrical and Computer Engineering, Las Cruces, NM USA
Design Techniques for Uniform-DFT, Linear Phase Filter Banks
Sun, Honglin, New Mexico State Univ., USA; DeLeon, Phillip, New Mexico State Univ., USA; Dec. 02, 1999; 18p; In English
Contract(s)/Grant(s): NAG5-1491; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Uniform-DFT filter banks are an important class of filter banks and their theory is well known. One notable characteristic is their very efficient implementation when using polyphase filters and the FFT. Separately, linear phase filter banks, i.e. filter banks in which the analysis filters have a linear phase are also an important class of filter banks and desired in many applications. Unfortunately, it has been proved that one cannot design critically-sampled, uniform-DFT, linear phase filter banks and achieve perfect reconstruction. In this paper, we present a least-squares solution to this problem and in addition prove that oversampled, uniform-DFT, linear phase filter banks (which are also useful in many applications) can be constructed for perfect reconstruction. Design examples are included illustrate the methods.
Author
Linear Filters; Fast Fourier Transformations; Wavelet Analysis

20000015355 Space and Naval Warfare Systems Command, San Diego, CA USA
Fiscal Year 1999 Wideband Antenna Feasibility Study: Man-Carried Ultrawideband Antenna System *Final Report*
Adams, R. C.; Haglind, C. P.; Pace, H. N., Jr.; Lebaric, J.; Adler, R.; Nov. 1999; 50p; In English
Report No.(s): AD-A371742; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Wideband Antenna Feasibility Study is an ongoing effort originally funded through the Amphibious Warfare Technology (AWT) Office at Marine Corps Systems Command (MARCORSYSCOM). This report gives a technical account of the achievements made during Fiscal Year 1999 (FY 1999). It describes the technical considerations addressed and the basis upon which the concept and specific designs were chosen. Theoretically derived predictions as well as test results are included with a concluding analysis and recommendations.
DTIC
Broadband; Antenna Design

20000017952 California Univ., Los Angeles, CA USA
Photonic-Crystal Antenna Substrates
Brown, Elliott R., California Univ., USA; McMahon, Oliver B., Lockheed Martin Co., USA; Parker, Christopher D., Massachusetts Inst. of Tech., USA; Lincoln Laboratory Journal; 1998; Volume 11, No. 2, pp. 159-174; In English
Report No.(s): AD-A369232; ESC-TR-98-074; MIT-JA-7534; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

A recently developed artificial dielectric, called a photonic crystal, provides an elegant and effective solution to the long-standing problem of fabricating high-performance planar antennas on substrates having high dielectric constants. The stop band of the photonic crystal rejects the majority of power radiated by an antenna mounted on its surface, without shorting out the driving-point impedance. This behavior makes the antenna more efficient than if it is mounted on a homogeneous substrate consisting of the same dielectric material as the photonic crystal. We experimentally measured antenna characteristics for bow-tie and dipole antennas on two types of photonic crystal: (1) conventional photonic crystals consisting of a periodic array of holes filled with air and embedded in a high dielectric material, and (2) metallodielectric photonic crystals (MDPCs) consisting of a periodic army of metallic spheres embedded in a low dielectric materials In some cases experiments show that the directive gain can greatly exceed that of the same antenna suspended in free space.
Author
Crystals; Dielectrics; Substrates; Photonics; Planar Structures

20000018007 Georgia Inst. of Tech., School of Electrical and Computer Engineering, Atlanta, GA USA

Numerical Examination of Silicon Avalanche Photodiodes Operated in Charge Storage Mode

Parks, Joseph W., Jr., Georgia Inst. of Tech., USA; Brennan, Kevin F., Georgia Inst. of Tech., USA; IEEE Transactions on Electron Devices; February 1998; ISSN 0018-9383; Volume 45, No. 2, pp. 394-419; In English

Contract(s)/Grant(s): NAGw-2753; Copyright; Avail: Issuing Activity, Hardcopy

The behavior of silicon-based avalanche photodiodes (APD's) operated in the charge storage mode is examined. In the charge storage mode, the diodes are periodically biased to a sub-breakdown voltage and then open-circuited. During this integration period, photo-excited and thermally generated carriers are accumulated within the structure. The dynamics of this accumulation and its effects upon the avalanching of the diode warrants a detailed, fully numerical analysis. The salient features of this investigation include device sensitivity to the input photo-current including the self-quenching effect of the diode and its limitations in sensing low light levels, the dependence of the response on the bulk lifetime and hence on the generation current within the device, the initial gain, transient response, dependence of the device uniformity upon performance, and the quantity of storable charge within the device. to achieve these tasks our device simulator, STEBS-2D, was utilized. A modified current-controlled boundary condition is employed which allows for the simulation of the isolated diode after the initial reset bias has been applied. With this boundary condition, it is possible to establish a steady-state voltage on the ohmic contact and then effectively remove the device from the external circuit while still including effects from surface recombination, trapped surface charge, and leakage current from the read-out electronics.

Author

Numerical Analysis; Silicon; Avalanche Diodes; Photodiodes; Steady State; Boundary Conditions

20000018008 California Inst. of Tech., Pasadena, CA USA

Low-Noise Submillimeter-Wave NbTiN Superconducting Tunnel Junction Mixers, *1999-2010*

Kawamura, J., California Inst. of Tech., USA; Chen, J., California Inst. of Tech., USA; Miller, D., California Inst. of Tech., USA; Kooi, J., California Inst. of Tech., USA; Zmuidzinas, J., California Inst. of Tech., USA; Bumble, B., California Inst. of Tech., USA; LeDuc, H. G., California Inst. of Tech., USA; Stern, J. A., California Inst. of Tech., USA; [1999]; 7p; In English

Contract(s)/Grant(s): NAG5-4890; NAGw-107; NAG2-1068; NSF AST-96-15025; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have developed a low-noise 850 GHz superconductor-insulator-superconductor (SIS) quasi-particle mixer with NbTiN thin-film microstrip tuning circuits and hybrid Nb/AlN/NbTiN tunnel junctions. The mixer uses a quasioptical configuration with a planar twin-slot antenna feeding a two-junction tuning circuit. At 798 GHz, we measured an uncorrected double-sideband receiver noise temperature of T(sub RX) = 260 K at 4.2 K bath temperature. This mixer outperforms current Nb SIS mixers by a factor of nearly 2 near 800 GHz. The high gap frequency and low loss at 800 GHz make NbTiN an attractive material with which to fabricate tuning circuits for SIS mixers. NbTiN mixers can potentially operate up to the gap frequency, 2(delta)/h is approximately 1.2THz.

Author

Mixing Circuits; SIS (Superconductors); Submillimeter Waves; Tunnel Junctions; Niobium Stannides; Fabrication; Electromagnetic Noise; Low Noise

20000018024 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

An Experimental Study on Liquid Fluorinert Cooling of High-Power IC Chips

Gima, Satoru, Kyushu Univ., Japan; Tomimura, Toshio, Kyushu Univ., Japan; Zhang, Xing, Kyushu Univ., Japan; Fujii, Motoo, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1999; ISSN 0914-3793; Volume 13, No. 2, pp. 75-80; In Japanese; No Copyright; Avail: Issuing Activity

Fluorinert cooling of high-power IC chips using a closed type thermosyphon loop is investigated fundamentally to cope with the recent rapid rise in heat dissipation density of notebook computers. The present experimental set-up consists of evaporator and condenser sections connected by flexible tubing. The evaporator section corresponds to a high-power IC chip, and the condenser section represents a cooling plate located behind a display of notebook computers. The evaporator has the size of 50mm X 50mm X 20mm outside dimensions, and the condenser is made of a copper plate with heat transfer area of 150 X 200 square mm and thickness of 1.5mm. The effects of the heat input, the filled volume of Fluorinert liquid and the inclination angle of condenser on the heat transfer characteristics of the system are studied experimentally.

Author

Cooling; Evaporators; Liquid Cooling; Chips (Electronics); Integrated Circuits; Fluorine

20000018025 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

Inductive Effect in NASICON-Type Cathodes for Lithium Secondary Batteries

Okada, Shigeto, Kyushu Univ., Japan; Takada, Tomoo, Kyushu Univ., Japan; Egashira, Minato, Kyushu Univ., Japan; Yamaki, Jun-Ichi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1999; ISSN 0914-3793; Volume 13, No. 2, pp. 81-85; In Japanese; No Copyright; Avail: Issuing Activity

We carried out redox-couple and counter-cation exchange in NASICON-type M2(XO4)3 (M: Fe and Al; X: S, Mo and W) to control the cathode performance. The FO(3+)/Fe(2+) redox potential in NASICON matrix is changed by the local crystalline field at the iron resulting from polarization of oxygen towards the counter cation in the polyanionic complex. It is confirmed by 57-Fe Mossbauer resonance, Fe-2p XPS, Mo K-XAFS and electrochemical measurements. This inductive effect in NASICON matrix is a significant material control technique for cathode design. We also found a promising anode candidate by ion exchange of Fe by Al in Fe2(MoO4)3 The reversible capacity of Al2(MoO4)3 reached almost 200 mAh/g between 3.5 V and 1.2 V. Author

Cathodes; Lithium Batteries; Oxidation-Reduction Reactions; Inductance

20000019573 New Mexico State Univ., Center for Space Telecommunications and Telemetering, Las Cruces, NM USA

FPGA-Based Filterbank Implementation for Parallel Digital Signal Processing

Berner, Stephan, New Mexico State Univ., USA; DeLeon, Phillip, New Mexico State Univ., USA; [1999]; 10p; In English
Contract(s)/Grant(s): NAG5-7520; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

One approach to parallel digital signal processing decomposes a high bandwidth signal into multiple lower bandwidth (rate) signals by an analysis bank. After processing, the subband signals are recombined into a fullband output signal by a synthesis bank. This paper describes an implementation of the analysis and synthesis banks using (Field Programmable Gate Arrays) FPGAs. Author

Signal Processing; Very Large Scale Integration; Systolic Arrays; Parallel Processing (Computers)

20000019576 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

Analog Module Architecture for Space-Qualified Field-Programmable Mixed-Signal Arrays

Edwards, R. Timothy, Johns Hopkins Univ., USA; Strohbehn, Kim, Johns Hopkins Univ., USA; Jaskulek, Steven E., Johns Hopkins Univ., USA; Katz, Richard, Johns Hopkins Univ., USA; Sep. 27, 1999; 16p; In English; 2nd; Military and Aerospace Applications of Programmable Devices and Technologies, 28-30 Sep. 1999, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Spacecraft require all manner of both digital and analog circuits. Onboard digital systems are constructed almost exclusively from field-programmable gate array (FPGA) circuits providing numerous advantages over discrete design including high integration density, high reliability, fast turn-around design cycle time, lower mass, volume, and power consumption, and lower parts acquisition and flight qualification costs. Analog and mixed-signal circuits perform tasks ranging from housekeeping to signal conditioning and processing. These circuits are painstakingly designed and built using discrete components due to a lack of options for field-programmability. FPAA (Field-Programmable Analog Array) and FPMA (Field-Programmable Mixed-signal Array) parts exist but not in radiation-tolerant technology and not necessarily in an architecture optimal for the design of analog circuits for spaceflight applications. This paper outlines an architecture proposed for an FPAA fabricated in an existing commercial digital CMOS process used to make radiation-tolerant antifuse-based FPGA devices. The primary concerns are the impact of the technology and the overall array architecture on the flexibility of programming, the bandwidth available for high-speed analog circuits, and the accuracy of the components for high-performance applications.
Author

Digital Systems; Fabrication; Logic Circuits; Programmable Logic Devices; Architecture (Computers); Logical Elements; Radiation Tolerance

20000019585 Army Construction Engineering Research Lab., Champaign, IL USA

Potential Army Application for Micro-Turbine Cogeneration Technology

Amsdorff, Cheri; Brewer, Michael K.; Sep. 1999; 61p; In English
Contract(s)/Grant(s): DACA-88-D-0002
Report No.(s): AD-A370920; CERL-TR-99/82; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Many U.S. Army installations pay relatively high prices for the electricity because they are remotely located. Moreover, Army facilities frequently have heat and electrical needs co-located in a building or cluster of buildings, which makes these locations well suited for energy ”cogeneration.” Micro-turbines are a miniaturized version of combustion turbines currently used in the aerospace and electric power industries. The micro-turbine’s simple construction, when coupled with the cost benefits of mass

production, is anticipated to yield electric power at low capitol costs. Also, the unit's exhaust stream is a high quality heat stream that can be used in a cogeneration system to meet steam or hot water needs co-located in the building. This study reviewed ongoing demonstrations to evaluate micro-turbine technology for possible application at Army installations.
DTIC
Remotely Piloted Vehicles; Electricity; Cogeneration; Turbines; Miniaturization

20000019622 Columbia Univ., Dept. of Electrical Engineering, New York, NY USA
Development of Low Loss Multipole RF Filters ***Final Report, Jul. 1996-Jul. 1999***
Ma, Q. Y.; Sep. 30, 1999; 30p; In English
Contract(s)/Grant(s): N00014-96-1-G017
Report No.(s): AD-A371011; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
During contract period, we have completed the technical objectives of this project. The highlights include: (1) Made, for the first time, 3-pole HTS filters in MHz range on 2-inch wafers. (2) Achieved an insertion loss of -0.7 dB and a return loss of -15 dB. (3) Invented an active switchable tuning method for turnable HTS filter. Overall, 2 papers have been published, 3 submitted, 5 conference papers presented and 3 patent applications submitted.
DTIC
High Temperature Superconductors; Bandpass Filters; Radio Frequencies

20000019623 Naval Postgraduate School, Monterey, CA USA
Design and Implementation of a Zero-Voltage-Switching, Pulse-Width-Modulated, High-Frequency, Resonant Buck Chopper
Turner, Clifton C., Jr; Sep. 1999; 148p; In English
Report No.(s): AD-A371024; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
As the Navy moves toward a modular DC Zonal Electrical Distribution System (DC ZEDS) to reduce both cost and weight over traditional radial shipboard distribution, there is a need to capitalize on technological advances currently available. The 21st century shipboard power distribution system calls for a DC bus architecture to eliminate the need for large transformers and thousands of pounds of cable through the use of high-speed semiconductor converters. In order to realize dramatic reductions in the size and cost of shipboard components through the use of high-speed switches, switch designs must be thoroughly investigated and tested. This thesis examines the use of soft-switching techniques fOr use in the future DC-to-DC power converter modules of the DC ZEDS. Soft-switching is analyzed here primarily with a DC down/converter (buck chopper). A low voltage buck chopper is simulated utilizing PSPICE and modeled in the lab. A voltage feedback control algorithm is developed and utilized with the PSPICE model. A comparative study of circuit efficiency is done between a single-source and a two-source soft-switched topology. Finally, recommendations are made for further simulation and modeling to evaluate soft-switching, high-voltage performance capabilities.
DTIC
Voltage Converters (DC to DC); Switching; Semiconductors (Materials); Design Analysis

20000019626 Erlangen-Nuernberg Univ., Erlangen, Germany
Proceedings of the Biennial Conference
Schulz, Max; Brendel, Rolf; Microeletronic Engineering; Sep. 1999; Volume 48, No. 1-4; 454p; In English; 11th; Insulating Films on Semiconductors, 16-19 Jun. 1999, Kloster Banz, Germany
Contract(s)/Grant(s): F61775-99-W-F057
Report No.(s): AD-A370926; EOARD-CSP99-5057; No Copyright; Avail: CASI; A04, Microfiche; A20, Hardcopy
The Final Proceedings for Insulating Films on Semiconductors, 16 June 1999 - 19 June 1999. This is an interdisciplinary conference. Topics include dielectrics, semiconductor/insulator interfaces, and the physics and technology of field effect (MIS, MOS) semiconductor devices, atomic scale processing, characterization and measurement techniques, radiation and hot carrier reliability, novel materials, and processing technologies. Special emphasis will be given to ultra thin oxides on silicon.
DTIC
Thin Films; Semiconductor Devices; Conferences; Dielectrics; Insulation; MIS (Semiconductors)

20000019627 Asian Office of Aerospace Research and Development, APO San Francisco, CA USA
Proceedings of the Topical Workshop
Arakawa, Y.; Hunt, C. E.; Klaassen, F. M.; Pearton, S. J.; Nov. 15, 1999; 342p; In English; Heterostructure of Microelectronics (TWHM '98), 30 Aug. 1998, Kanagawa, Japan
Contract(s)/Grant(s): F62562-98-M-9082; F62562-98-M-9196
Report No.(s): AD-A370927; AOARD-CSP98-03; No Copyright; Avail: CASI; A03, Microfiche; A15, Hardcopy

Topics included in the proceedings include the following: (1) "High-Speed and High-Frequency Devices"; (2) "Novel Devices"; (3) "Microwave/Millimeter Wave Devices"; (4) "Wide Bandgap Devices"; (5) "Circuit Applications, Device Fabrication and Characterization"; (6) "Systems Applications"; (7) "High-Speed ICS for Optical Communication Systems"; and (8) "Manufacturing".
DTIC
Conferences; Microelectronics; Optical Equipment; Fabrication

20000019629 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Magnetic Design for Low-Field Tunability of Microwave Ferrite Resonators
Dionne, Gerald F., Massachusetts Inst. of Tech., USA; Oates, Daniel E., Massachusetts Inst. of Tech., USA; Journal of Applied Physics; May 15, 1999; ISSN 0021-8979; Volume 85, No. 8, pp. 4856-4858; In English
Contract(s)/Grant(s): F19628-95-C-0002
Report No.(s): AD-A366550; MS-12982; ESC-TR-98-059; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

An advanced microstrip resonator design consisting of a ferrite substrate formed in a closed magnetic path (toroidal structure) is shown to produce substantially improved tunability over previous versions that operated in an external magnetic field. Magnetically tunable toroidal resonators with tunability approaching 10% in magnetic fields of 60 Oe have been demonstrated using conventional ferrite compositions. Calculations with a hysteresis-loop theory developed specifically for modeling the low-field magnetization of ferrites were successfully fitted to resonator frequencies measured as a function of magnetic field. Performance predictions for resonators with ferrites optimized for low-field magnetization properties suggest that tunability approaching 15% is possible at magnetic fields of less than 5 Oe.
Author
Ferrites; Magnetic Fields; Tuning; Magnetization; Microwave Oscillators

20000019656 TPL, Inc., Albuquerque, NM USA
Novel Composite Dielectrics for High Energy Density Capacitors ***Final Report, 18 May - 18 Nov. 1999***
Slenes, Kirk; Luther, Erik; Labanowski, Chris; Romero, Thomas; Dec. 15, 1999; 12p; In English
Contract(s)/Grant(s): F33615-99-C-2958
Report No.(s): AD-A371661; TPL-AD15-FR-99; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This Phase I contract was successfully performed and has led to a significant advancement in capacitor technology. Feasibility of producing state-of-the-art high temperature dielectric films with high energy density capabilities has been established. Results from this program support the potential for polyimide based capacitors with thermal stability and energy density twice that of conventional dielectrics. All proposed program tasks were successfully completed. First, unique polyimide/siloxane compositions were developed with high temperature (> 2000 C) and high energy density capabilities (> 4.0 J/cc). Second, high dielectric constant composites were developed using the polyimides in combination with TPL's nanosize barium titanate powder. Third, continuous filing production processes were established for the polymer and the composite. Rolls of capacitor quality film were produced to a thickness of 2.0 microns. Significant opportunities exist for continued developments. Knowledge gained on material development and film fabrication can be applied to construction wound capacitors. The Phase II proposal will focus on the fabrication of high energy density prototype devices for use in high temperature environments. Several commercial and government applications are anticipated to benefit from this technology: under hood automotive, down hole well drilling and aircraft/spacecraft engine compartments.
DTIC
Dielectrics; Capacitors; Flux Density

20000019681 Massachusetts Inst. of Tech., Microsystems Technology Labs., Cambridge, MA USA
Computer-Aided Prototyping of Advanced Microsystems Technology ***Final Report, 27 Sep. 1995 - 31 Dec. 1998***
Antoniadis, Dimitri A.; Dec. 31, 1998; 20p; In English
Contract(s)/Grant(s): DABT63-95-C-0088
Report No.(s): AD-A359671; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Our goal in this program was to develop process and layout-specific models and simulations for interconnect reliability and to use these tools in developing a tool for making process-sensitive and layout-specific circuit-level interconnect reliability simulations. This tool will provide a means of making much more accurate reliability assessments, will allow process and layout design for optimized interconnect reliability, will allow rapid evaluation of the impact of changes in materials and processes on interconnect reliability, and will provide the bases for quantitatively assessing the trade-off between performance and reliability during design and fabrication of high performance integrated circuits.
DTIC
Computer Techniques; Layouts; Prototypes; Computer Aided Design; Microelectronics

20000020830 Army Tank-Automotive and Armaments Command, Warren, MI USA
Ground Vehicle Mobility Requirements: Meeting the Challenge with Electric Drives
Khalil, G., Army Tank-Automotive and Armaments Command, USA; Hitchcock, Jennifer, Army Tank-Automotive and Armaments Command, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 1-1 - 1-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Military ground vehicle requirements are defined by the terrains they traverse and the performance specifications defined by the users. While terrains have not changed much throughout the history of ground vehicles, the performance specifications have always evolved with the ever changing technologies and the threats associated with them. This paper contains a summary of current and future vehicle requirements, and the enabling technologies necessary for meeting them, including prime power sources which range from conventional engines to fuel cells. Among the various technologies under consideration for future vehicle needs, electric drive stands out as a leading candidate. Therefore, a good portion of the paper is dedicated to electric drive systems and their impact on vehicle missions; particularly mobility.
Author
Surface Vehicles; Electric Automobiles; Design Analysis; Propulsion; Functional Design Specifications

20000021010 Mission Research Corp., Newington, VA USA
High-Sensitivity Broad-Frequency-Response Fiber-Optic Radio-Frequency (RF) Field Sensor ***Final Report, Mar. 1997 - Dec. 1998***
Smith, Richard S.; Koves, Laszlo; Dec. 1999; 42p; In English
Contract(s)/Grant(s): F30602-97-C-0044; AF Proj. 2338
Report No.(s): AD-A371773; MRC/WDC-R-439R; AFRL-IF-RS-TR-1999-252; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Mission Research Corporation has developed a minimally-perturbing, broadband, fiber-optic RF probe for AFRL, Rome. This probe operates from 100 MHz to 18 GHz as limited by an output low-noise amplifier. Without its output amplifier, its response is flat from below 1 MHz to 8 GHz, but drops considerably from 8 GHz to 18 GHz. The probe outputs an RF signal proportional to the RF field at the probe head. This frequency response along with dipole-like antenna patterns at 2, 8, and 15 GHz were measured at AFRL, Rome, NY. The output RF voltage is approximately 10 -4 meters times the field (below 8 GHz). The noise-equivalent RF field level is tenths of mV/m times the square root of the noise bandwidth of the read-out device (e.g., the resolution bandwidth of a read-out spectrum analyzer). Advantages of the probe include very low perturbation of the fields being measured, a single fiber to the probe head (separate input and output fibers are not needed), and control of sensitivity stability from the data-room end of the fiber.
DTIC
Frequency Response; Fiber Optics; Radio Frequencies; Electromagnetic Fields

20000021011 Air Force Research Lab., Information Directorate, Rome, NY USA
X Windows-Based Interactive Test Patterns for Overlaid Stereoscopic and Tiled Displays
Jedrysik, Peter A.; Sweed, Richard H.; VanPelt, Robert; Dec. 1999; 40p; In English
Contract(s)/Grant(s): Proj-558S
Report No.(s): AD-A371772; AFRL-IF-RS-TR-1999-251; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Composite display systems consisting of multiple video projectors and/or direct view monitors are becoming more commonplace as the needs for 3D stereoscopic viewing and very high-resolution large screen displays become more prevalent. In these installations, the goal is to take separate elements and obtain a single amalgamated view. The object of this in-house task was to develop a number of interactive display patterns that would provide a more accurate, time saving means to test and align video projects in a tiled Data wall configuration and an overlaid stereoscopic configuration. Several of these Composite display

systems are currently implemented in the Advanced Displays and Intelligent Interlaces (ADII) visualization Facility at the Information Directorate of AFRL, in Rome, NY.
DTIC
Windows (Computer Programs); Display Devices

20000021075 Michigan Univ., Radiation Lab., Ann Arbor, MI USA
A New Generation of Antenna Structures Based on Novel Composite Materials ***Final Report, 1 Aug. 1998 - 31 May 1999***
Katehi, Linda P.; Sarabandi, Kamal; Nov. 22, 1999; 9p; In English
Contract(s)/Grant(s): 037348; DAAG55-98-1-0412
Report No.(s): AD-A371503; ARO-37353.1-EL-II; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

Antenna miniaturization is always desirable as the communication apparatus becomes more and sophisticated and the physical space becomes an expensive commodity. It is possible to reduce the size of the antenna by altering its shape and the properties of the material it is made of. In this study, we load a slot ring radiator with a finite dielectric lens, which increases the propagation constant around the antenna as well as over its aperture and therefore relaxes the size requirement. The amount of miniaturization depends both on the electromagnetic properties as well as the volume of the lens. The regular practice is to choose a pure dielectric and employ a high permittivity. However, controlling the loss becomes a major issue at high dielectric constants. Or one may choose to use a larger or thicker lens together with a lower permittivity. We chose to study a lens with electrical as well as magnetic properties (relative permeability is larger than unity), because the effective propagation constant is proportional to the product of the effective permittivity and permeability (square root of mu(r), epsilon(r)), the use of magnetic materials will relax the requirement on high values of permittivity for a small size of the lens antenna.
DTIC
Antenna Arrays; Antenna Components; Composite Materials

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.

20000014450 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Direct-Numerical and Large-Eddy Simulations of a Non-Equilibrium Turbulent Kolmogorov Flow ***Final Report***
Woodruff, S. L., Institute for Computer Applications in Science and Engineering, USA; Shebalin, J. V., NASA Langley Research Center, USA; Hussaini, M. Y., Institute for Computer Applications in Science and Engineering, USA; December 1999; 24p; In English
Contract(s)/Grant(s): NAS1-19480; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209727; NAS 1.26:209727; ICASE-99-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A non-equilibrium form of turbulent Kolmogorov flow is set up by making an instantaneous change in the amplitude of the spatially-periodic forcing. It is found that the response of the flow to this instantaneous change becomes more dramatic as the wavenumber of the forcing is increased, and, at the same time, that the faithfulness with which the large-eddy-simulation results agree with the direct-numerical results decreases.
Author
Direct Numerical Simulation; Large Eddy Simulation; Equilibrium Flow; Turbulent Flow; Kolmogorov Theory

20000019637 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Easy Turbulence
Gawedzki, Krzysztof, Institut des Hautes Etudes Scientifiques, France; July 1999; 28p; In English
Report No.(s): PB2000-100761; IHES/P/99/56; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

It seems a safe bet that the understanding of developed turbulence, a long standing challenge for theoretical and mathematical physics, will enter into the third millenium as an unsolved problem. This is an introductory course on the subject. We discuss: the Navier Stokes equations, existence of solutions, statistical description, energy balance and cascade picture; the Kolmogorov theory of three-dimensional turbulence versus intermittency, the Kraichnan-Batchelor theory of two-dimensional turbulence; the

Richardson dispersion law and a breakdown of the Lagrangian flow; and direct and inverse cascades and intermittency in the Kraichnan model of passive advection.
Derived from text
Turbulence; Theoretical Physics

20000019645 Sydney Univ., Dept. of Civil Engineering, Australia
Organic Contamination of Stratified Porous Media: Three-Dimensional Transport with Non-Equilibrium Partitioning by Boundary Elements ***Topical Report***
ElZein, Abbas H., Sydney Univ., Australia; Booker, John R., Sydney Univ., Australia; Oct. 1999; 82p; In English
Report No.(s): PB2000-102503; RR-R796; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

A three-dimensional boundary element solution of the time-dependent diffusive/advective equation in non-homogeneous soils with both physical and chemical non-equilibrium processes is developed. Saturated conditions and rate-limited mass transfer are assumed. The Laplace transform remove the need for time-stepping and the associated numerical complexity, and the use of Green's functions yields accurate solutions of infinite domains such as soils as well as media with finite dimensions. The solution requires boundary discretization only and can therefore be a valuable tool in bio-remediation and landfill design where different geometries, soil properties and pollutant loads may be analyzed at low cost. The proposed technique is validated by comparing its predictions to analytical solutions obtained for different types of soil and contaminant sources. The scope of the method is illustrated by analyzing the contamination of multi-layered soils by a neighboring river and a surface source.
NTIS
Three Dimensional Flow; Organic Compounds; Contaminants; Boundary Element Method

20000019657 Massachusetts Inst. of Tech., Dept. of Aeronautics and Astronautics, Cambridge, MA USA
Unsteady and Three-Dimensional Flow in Turbomachines ***Final Report, 1 Mar. 1996 - 30 Sep. 1999***
Tan, C. S.; Epstein, A. H.; Greitzer, E. M.; Kerrebrock, J. L.; Dec. 1999; 32p; In English
Contract(s)/Grant(s): F49620-96-1-0266
Report No.(s): AD-A371752; AFRL-SR-BL-TR-99-0304; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report describes work carried out at the Gas Turbine Laboratory at MIT during the period 3/1/96-9/30/99, as part of a multi-investigator effort on unsteady and three dimensional flow phenomena in turbomachines. Within the overall project, three separate tasks are specified. These are, in brief: (1) Characterization of Fully-Scaled, Unsteady Film-Cooled Turbine Blade Heat Transfer and Aerodynamics; (2) Flow Control in Compression Systems by Viscous Flow Removal; and (3) Unsteady Phenomena in Turbomachinery Endwall Flows.
DTIC
Unsteady Flow; Computational Fluid Dynamics; Gas Turbines

20000020747 Sydney Univ., Dept. of Civil Engineering, Australia
Organic Contamination of Stratified Porous Media: Two-Dimensional Transport with Non-Equilibrium Partitioning by Boundary Elements ***Topical Report***
ElZein, Abbas H., Sydney Univ., Australia; Booker, John R., Sydney Univ., Australia; Oct. 1999; 44p; In English
Report No.(s): PB2000-102502; RR-R795; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

A boundary element reduced to a transport-based non-equilibrium equations in the Laplace domain is extended to include multiple sources of non-equilibrium processes in saturated media under the assumption of rate-limited mass transfer. Green functions accurately model infinite and semi-infinte domains such as soils and Laplace transforms remove the need for time-stepping and the associated numerical complexity. The proposed numerical technique is validated by comparing its results to analytical solutions. Its scope is illustrated through a case study of a sand aquifer bounded be less permeable layers of silt, and infiltrated by pollutants from a neighboring lake.
NTIS
Two Dimensional Flow; Organic Compounds; Contaminants; Boundary Element Method

20000020812 Rolls-Royce Ltd., Technology Dept., Derby, UK
Part Speed Flutter of Transonic Fans
Chew, J. W., Rolls-Royce Ltd., UK; Hamby, R. J., Rolls-Royce Ltd., UK; Marshall, J. G., Rolls-Royce Ltd., UK; Vahdati, M., Imperial Coll. of Science Technology and Medicine, UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 26-1 - 26-10; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Until recently, only rudimentary methods have been available to assess designs for susceptibility to part speed flutter, but progress is now being made with more advanced CFD-based models. Earlier work has shown that coupled structural-fluid, non-linear methods may usefully be applied to this problem, but have also indicated that more computationally efficient linear methods have a role. One such linear approach is described in this paper and demonstrated on two research fans, representative of civil and military engines. Calculations are consistent with experimental observations in that the civil fan was found susceptible to flutter while the military fan was not. The results confirm the utility of the linear approach and give further insight into the physics of this type of flutter.
Author
Computational Fluid Dynamics; Mathematical Models; Turbofans; Transonic Flutter

20000020838 Middle East Technical Univ., Chemical Engineering Dept., Ankara, Turkey
A Novel Code for the Prediction of Transient Flow Field in a Gas Turbine Combustor Simulator
Selcuk, Nevin, Middle East Technical Univ., Turkey; Oymak, Olcay, Babcock and Wilcox Gama Boiler Technology, Inc., Turkey; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 11-1 - 11-10; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

In the present paper, numerical simulation of time-dependent two dimensional Navier-Stokes equations for incompressible separated internal flow was carried out by using the method-of-lines approach in conjunction with (1) an intelligent higher-order spatial discretization scheme, (2) a parabolic algorithm for the computation of pressure, and (3) an elliptic grid generator using body-fitted curvilinear coordinate system for application to complex geometries. The proposed code was applied to predict the time development of turbulent, cold flow in a gas turbine combustor simulator. Predictions were found to be in reasonable agreement with measured data. The code provides an algorithm for future direct numerical simulation applications.
Author
Gas Turbines; Combustion Chambers; Combustion; Incompressible Flow; Navier-Stokes Equation; Turbulent Flow; Unsteady Flow; Computational Grids; Applications Programs (Computers); Air Flow; Cold Gas

20000020840 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
Numerical Simulation of the Reactive Flow in a Tubular Chamber with Detailed Kinetic Effects
Zamuner, B., Office National d'Etudes et de Recherches Aerospatiales, France; Bourasseau, B., Office National d'Etudes et de Recherches Aerospatiales, France; Berat, C., Turbomeca S.A. - Brevets Szydlowski, France; Niemann, H., Heidelberg Univ., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 13-1 - 13-12; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Numerical simulation of turbulent flows in gas turbine combustors plays today a major role in the design of new concepts of combustion chambers. Indeed, the enforcement of strict environmental regulations urges gas turbine manufacturers to find out new solutions in order to reduce pollutants emissions. Lean premixed injection seems to be a promising way, but it poses the problem of flame stability induced by non extremely fast chemically controlled reaction rates. In the present study. kinetic effects are incorporated in the turbulent CFD simulations of a methane/air tubular chamber developed at TURBOMECA by means of an original approach. First, a classical numerical code (DIAMANT), which solves the 3D Reynolds Averaged Navier Stokes (RANS) equations with an algebraic fast chemistry combustion model, is used to compute the main features of the mean flow. Then, a more sophisticated turbulent combustion model, called PEUL+ (Probabilistic Eulerian-Lagrangian) model, is coupled with the RANS solver in order to account for detailed kinetic effects. The PEUL+ model consists in solving the joint probability density function (PDF) transport equation by a Monte Carlo technique. This approach has the great advantage of directly taking into account, without modelling, chemical source terms coming from detailed kinetic mechanisms for fuel oxidation. to avoid CPU expensive computations, chemical source terms are evaluated, in this work, by an Intrinsic Low Dimensional Manifold (ILDM) technique, a new interesting tabulation method which keeps the complex behaviour of a detailed kinetic system, while describing its dynamics with only two or three progress variables. The PEUL+ model with the ILDM table for methane-air mixture is applied to the tubular chamber at atmospheric pressure. Results are compared with infinitely fast combustion model simulations.
Author
Combustion Chambers; Gas Turbines; Computerized Simulation; Gas Mixtures; Navier-Stokes Equation; Reaction Kinetics; Reynolds Averaging; Turbulent Combustion; Turbulent Flow

20000020852 Sener S.A., Madrid, Spain

Turbulent Structure of Generic LPP Gas Turbine Combustors

Lazaro, B., Sener S.A., Spain; Gonzalez, E., Universidad Politecnica de Madrid, Spain; Alfaro, J., Universidad Carlos 3 de Madrid, Spain; Rodriguez, P., Universidad Carlos 3 de Madrid, Spain; Lecuona, A., Universidad Carlos 3 de Madrid, Spain; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 25-1 - 25-12; In English; See also 20000020829; Original contains color illustrations

Contract(s)/Grant(s): CEC-BRPR-CT95-0122; CICYT-C95013002; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

An experimental investigation has been carried out aimed at increasing the knowledge of the turbulent flow features that characterize lean premixed prevaporized combustors for aircraft gas turbine applications. Taking into account constrains imposed by the available facilities, the design of the experimental rigs was performed to reproduce the combustor geometry and conditions being investigated under the EU sponsored LOWNOX-III program. Two different facilities were built, allowing both isothermal and reacting flow characterizations. Flow visualization, and two-component LDA and PIV systems were used as experimental techniques. Initial characterizations are presented and discussed in relation to technological relevant aspects such as combustor stability, efficiency and pollutant generation behavior.

Author

Combustion Chambers; Gas Turbine Engines; Premixing; Pollution Control; Exhaust Gases; Combustion Products; Turbulent Flow; Turbulent Combustion

20000020856 Sheffield Univ., Dept. of Chemical and Process Engineering, UK

The Use of Fluidics in Gas Turbine Combustion Design

Woolhouse, R. J., Sheffield Univ., UK; Tippetts, J. R., Sheffield Univ., UK; Whiteman, M., Sheffield Univ., UK; Young, K. J., Sheffield Univ., UK; Beck, S. B. M., Sheffield Univ., UK; Swithenbank, J., Sheffield Univ., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 33-1 - 33-10; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Current legislation demands clean combustion in gas turbines. One line of work concerning this objective at the University of Sheffield uses no-moving-part fluidic techniques to modulate flow in the combustor. Schemes described include BLC swirl vanes, a multi-inlet ”modulated swirl combustor”, a switched vortex valve to provide ”fluidic VAD” and multiple ejector systems to recover mixing energy from the fuel supply. A brief description is given of a recently-started project which uses a so-called ”turn-up vortex valve” as a fuel injection device to modulate the through flow and the flowfield thereby achieving a form of variable air distribution.

Author

Air Flow; Combustion; Gas Turbine Engines; Engine Design; Vortices; Combustion Chambers

20000020865 Technische Univ., Darmstadt, Germany

Optical Measurements of Jet-Mixing in a Swirling Crossflow of a Combustion Chamber

Krautkremer, B. H., Technische Univ., Germany; Blomeyer, M. M., Technische Univ., Germany; Hennecke, D. K., Technische Univ., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 42-1 - 42-11; In English; See also 20000020829; Original contains color illustrations

Contract(s)/Grant(s): BMFT-20T9607F; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

An experimental investigation of isothermal jet-mixing in a swirling crossflow has been conducted using a planar Miescattering technique. The mixing process has been studied in a plane model of an annular combustor segment. Aiming at a lean combustion concept, emphasis was put on both the process of homogenizing in the dilution zone and the transport of secondary air into the primary zone, driven by the recirculating flow of the airblast type atomizers which have been used as swirl generating devices without fuel addition. As consequence of the observed dependence of jet penetration on the swirling flow pattern a variation of swirler type and rotation direction under retention of the swirl number has been conducted. For a quantitative study of the mixing process also temperature measurements using the analogy between heat and mass transfer have been employed. The principal observations were: Mixing and homogenizing in the dilution zone is improved by the addition of swirl to the mainstream; Due to the three-dimensional flow field of the swirling mainstream the global momentum flux ratio has to be replaced by a local momentum flux ratio considering it as an indicator for jet penetration depth; This effect is very distinctive for the wall attached swirlers and weak for the wall detached ones; Mixing quality is better using wall attached swirlers; The tendency of all swirler configurations to pulsation causes also a time dependence of jet penetration; The pulsation caused an aerodynamic

instability with effects on flow-split and mixing of the secondary air; and Orifice diameter and spacing determine the mass-split of secondary air into main and dilution zone.
Author
Optical Measurement; Jet Mixing Flow; Combustion Chambers; Combustion; Cross Flow; Swirling; Three Dimensional Flow; Temperature Measurement

20000021077 Naval Undersea Warfare Center, Newport, RI USA
Direct Measurement of the Mode O Turbulent Boundary Layer Wall Pressure and Wall Shear Stress Spectra Using Air-Backed and Oil-Filled Multichannel Wavenumber Filters ***Final Report***
Peloquin, Mark S.; May 10, 1999; 153p; In English
Report No.(s): AD-A371294; NUWC-NPT-TR-11012; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This report describes research that resulted in the first direct multichannel measurements of the wall pressure and wall shear stress spectra beneath a turbulent boundary layer formed over a long, thin cylinder in an axial flow field. These measurements, processed as wavenumber-frequency spectra, were made with a multichannel array composed of an air-backed cylinder structure and a 32-channel aperture of PVDF film sensors having an axisymmetric response with respect to the array circumference. The measurements resolve the wavenumber spectrum in the +/- 131-rad/m range. Unexpected results were observed at a 5-knot freestream flow speed, where the magnitude of the wall shear stress convective ridge level exceeded the magnitude of the wall pressure convective ridge level. From 10 to 20 knots, the traditional relationship was observed, in which the wall pressure magnitude exceeds the wall shear stress magnitude in the vicinity of the convective ridge. Additionally, accurate resolution of the shape of the convective ridge as a function of wavenumber was accomplished with the air-backed cylinder array. An experimental calibration of the ”hose transfer function” for pressure was obtained by using data from an array of ceramic hydrophones mounted interior to an oil-filled cylinder in unison with data from the air-backed cylinder array. Theoretical dynamic elasticity simulations were required to remove the effects of the surface-generated pressure fields, which were different for each structure. Previous to this research, a mathematical model of the hose transfer function was used without the aid of experimental data or verification of any kind. The oil-filled array measurements spanned the wavenumber spectrum in the +/- 206-rad/m range and included measurements at kappa = 0 that were free from acoustic contamination.
DTIC
Turbulent Boundary Layer; Noise Reduction; Mathematical Models; Shear Stress; Noise (Sound)

35
INSTRUMENTATION AND PHOTOGRAPHY

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

20000020673 NASA Ames Research Center, Moffett Field, CA USA
Sensors 2000! Program: Advanced Biosensor and Measurement Systems Technologies for Spaceflight Research and Concurrent, Earth-Based Applications
Hines, J., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 578; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
Sensors 2000! (S2K!) is a specialized, integrated projects team organized to provide focused, directed, advanced biosensor and bioinstrumentation systems technology support to NASA’s spaceflight and ground-based research and development programs. Specific technology thrusts include telemetry-based sensor systems, chemical/ biological sensors, medical and physiological sensors, miniaturized instrumentation architectures, and data and signal processing systems. A concurrent objective is to promote the mutual use, application, and transition of developed technology by collaborating in academic-commercial-govemment leveraging, joint research, technology utilization and commercialization, and strategic partnering alliances. Sensors 2000! is organized around three primary program elements: Technology and Product Development, Technology infusion and Applications, and Collaborative Activities. Technology and Product Development involves development and demonstration of biosensor and biotelemetry systems for application to NASA Space Life Sciences Programs; production of fully certified spaceflight hardware and payload elements; and sensor/measurement systems development for NASA research and development activities. Technology Infusion and Applications provides technology and program agent support to identify available and applicable technologies from multiple sources for insertion into NASA’s strategic enterprises

and initiatives. Collaborative Activities involve leveraging of NASA technologies with those of other government agencies, academia, and industry to concurrently provide technology solutions and products of mutual benefit to participating members. Author

Biotelemetry; Bioinstrumentation; Telemetry; Technology Utilization; Product Development; Data Processing Equipment

20000020674 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Miniature Quadrupole Mass Spectrometer Array

Karmon, D., Jet Propulsion Lab., California Inst. of Tech., USA; Darrech, M., Jet Propulsion Lab., California Inst. of Tech., USA; Chutjian, A., Jet Propulsion Lab., California Inst. of Tech., USA; Jan, D., Jet Propulsion Lab., California Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 579; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

JPL is funded by Code U to develop a Miniature QMSA for an EVA flight test. The initial intent was to fly an experiment internal to the astronaut suit during a shuttle EVA. Following discussions with JSC the suit application was abandoned in favor of other more urgent needs. The JSC EVA office was particularly interested in hydrazine detection on the astronaut suit. While discussing and exploring the implementation of such an experiment, managers at JSC suggested combining the interests of two JSC groups. The Life Support and Thermal Systems Branch, Crew and Thermal Systems Division has a need for an ammonia detection instrument, while the EVA office has a need for hydrazine detection. The two groups were pursuing separate single-purpose solutions. Instead, the JPL QMSA offers a single instrument solution via a portable instrument to be used by an astronaut on an EVA. Such an instrument would serve both the ammonia leak detection and the hydrazine contamination needs. The need for the QMSA was defined as urgent and targeted for a January 1999 flight. While the original JPL task (as funded by Code U) was for an experiment flight with JPL delivery in October 1998, this task was for a qualified flight instrument with a planned JPL delivery in August 1998. This schedule was very demanding and dictated a fast-tract implementation. Author

Miniaturization; Quadrupoles; Mass Spectrometers; Arrays; Product Development; Hydrazines; Detection

20000020677 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

Miniature Time-of-Flight Mass Spectrometer

Potember, R. S., Johns Hopkins Univ., USA; Bryden, W. A., Johns Hopkins Univ., USA; Antoine, M., Johns Hopkins Univ., USA; Scholl, P., Johns Hopkins Univ., USA; Ko, H., Johns Hopkins Univ., USA; Pisacane, V. L., Johns Hopkins Univ., USA; Leonardo, M., Johns Hopkins Univ., USA; Cotter, R. J., Johns Hopkins Medical Institutions, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 582-583; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Major advances must occur to protect astronauts from prolonged periods in near-zero gravity and high radiation associated with extended space travel. The dangers of living in space must be thoroughly understood and methods developed to reverse those effects that cannot be avoided. Six of the seven research teams established by the National Space Biomedical Research Institute (NSBRI) are studying biomedical factors for prolonged space travel to deliver effective countermeasures. to develop effective countermeasures, each of these teams require identification of and quantification of complex pharmacological, hormonal, and growth factor compounds (biomarkers) in humans and in experimental animals to develop an in-depth knowledge of the physiological changes associated with space travel. At present, identification of each biomarker requires a separate protocol. Many of these procedures are complicated and the identification of each biomarker requires a separate protocol and associated laboratory equipment. to carry all of this equipment and chemicals on a spacecraft would require a complex clinical laboratory; and it would occupy much of the astronauts'time. What is needed is a small, efficient, broadband medical diagnostic instrument to rapidly identify important biomarkers for human space exploration. The Miniature Time-Of- Flight Mass Spectrometer Project in the Technology Development Team is developing a small, high resolution, time-of-flight mass spectrometer (TOFMS) to quantitatively measure biomarkers for human space exploration. The TOFMS will be used to identify and quantify biomarkers and support biomedical research and medical care. Several semi-quantitative miniature TOF mass spectrometers are presently under development at The Johns Hopkins University Applied Physics Laboratory (JHU/APL) for a DARPA program to analyzer to chemical and biological weapons with the sensitivity and mass range also required for human space exploration. A goal of this program is to develop a quantitative TOF mass spectrometer demonstration system from engineering model instruments available from the DARPA program. The virtue of the JHU/APL TOFMS technologies resides in the promise for a small (less than one cubic ft), lightweight (less than 5 kg), low power (less than 50 watts), rugged device that can be used continuously with advanced signal processing diagnostics. to date, the JHU/APL approach has demonstrated mass capability resolution from under 100 to beyond 10,000 atomic mass units (amu) in a very small, low power prototype for biological analysis. Further, the electronic nature of the TOFMS output makes it ideal for rapid telemetry to Earth for indepth analysis by ground support teams. The TOFMS Team has

completed initial laboratory studies with critical biomarkers identified by the Muscle Alterations and Atrophy Team. The TOFMS Team has recorded full spectrum mass spectral signature of key target biomarker analytes using the MALDI technique at physiological concentrations found in urine.
Author
Miniaturization; Time of Flight Spectrometers; Biomedical Data; Countermeasures; Diagnosis; High Resolution; Mass Spectrometers; Weightlessness

20000020681 Cleveland Clinic Foundation, Cardiovascular Imaging Center, Cleveland, OH USA
Digital Echocardiography on the International Space Station: Technical Progress and Experimental Planning
Thomas, J. D., Cleveland Clinic Foundation, USA; Greenberg, N. L., Cleveland Clinic Foundation, USA; Shiota, T., Cleveland Clinic Foundation, USA; Cardon, L., Cleveland Clinic Foundation, USA; Garcia, M. J., Cleveland Clinic Foundation, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 587-589; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

To provide improved experimental data concerning the effects of microgravity on the cardiovascular system, NASA plans to place a commercial echocardiograph on the International Space Station (ISS), with launch tentatively scheduled for December 1999. Before this can occur, however, a great deal of background work has been necessary to specify the precise configuration for this unit and develop and validate the methodology for digital transfer of echocardiographic data from the ISS to the ground. Additionally, one of the key goals of this instrument is to assess changes in intrinsic ventricular systolic and diastolic function during prolonged space flight independent of known changes of cardiac preload. Extensive ground- based work has been needed to validate the load independence of novel echocardiographic modalities such as Doppler tissue imaging (measuring velocities within the myocardium, rather than the blood pool) and color M-mode flow propagation (measuring the diastolic propagation of blood from the atrium to the ventricle, shown to be highly sensitive to intraventricular pressure gradients). Finally, recognizing that two-dimensional echocardiography is difficult for the crew to perform on orbit, work has been necessary to investigate the potential for three-dimensional echocardiography on future space missions.
Author
Cardiovascular System; Echocardiography; Experiment Design; Digital Data; Imaging Techniques; Microgravity

20000020786 Naval Postgraduate School, Monterey, CA USA
Investigation of Minimum Resolvable Temperature Difference Formulation for Polarized Thermal Imaging Range Prediction
Guimaraes, Edson F.; Sep. 1999; 149p; In English
Report No.(s): AD-A370908; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Previous measurements have demonstrated that a polarization filter can increase ship-background temperature contrast in the infrared, while decreasing the received radiance. Application of this technique to increasing range for detection or recognition of ship targets is being investigated through detection range modeling for a generic FLIR sensor. Laboratory measurements have been made of effective Minimum Resolvable Temperature Difference (MRTD) of a serial-scan 8-12 micrometers sensor for polarized and unpolarized radiation. A variety of standard four-bar target boards of varied spatial frequency and controlled bar-background temperature difference were used to construct MRTD vs. spatial frequency. Results were compared with model predictions using known or measured component parameters for the AGA-780 imager, showing close agreement for observations made by a "trained observer." A modified form of MRTD was developed for a polarized target using a reformulation of the thermal derivative of Planck's law. Modeled and measured values agreed closely for the unpolarized case, and also for both vertically and horizontally polarized cases when the appropriate parameters of the polarization filters were included. Mathematical analysis and measurement agreed in displaying an increase in MRTD with polarization. Predictions of maximum detection and recognition ranges using estimates of polarized effective target-background temperature difference indicated probable range improvement for sea surface degree of polarization in excess of 20%.
DTIC
FLIR Detectors; Target Recognition; Images; Thermal Mapping

20000020969 National Inst. of Standards and Technology, Precision Engineering Div., Gaithersburg, MD USA
NIST Gage Block Calibration Software System User's Manual
Zimmerman, J. H., National Inst. of Standards and Technology, USA; Jan. 2000; 256p; In English; Sponsored in part by Air Force Metrology and Calibration (AFMETCAL) Detachment 1, Heath, OH
Report No.(s): PB99-168320; NISTIR-6387; No Copyright; Avail: CASI; A03, Microfiche; A12, Hardcopy

Introduction to the User's Manual; Gage Blocks and Instrumentation Specifications; Microcomputer Hardware and Software Specifications; The NIST Gage Block Calibration Software System; The Accessory Software Programs; The Calibration and Measurement Software Programs; Using the NIST Gage Block Calibration Software System; References; The Accessory Software; NIST Gage Block Calibration and Measurement Software; NIST Gage Block Calibration and Measurement Software's Configuration Files; NIST Gage Block Calibration and Measurement Software's Mecmap Program's Configuration File; NIST Gage Block Calibration and Measurement Software's Probe Program's Configuration Files; NIST Gage Block Calibration and Measurement Software's Report Program's NIST Reports' of Calibration Documentation Files; and NISt Gage Block Calibration and Measurement Software's Spectrum Program's Configuration Files.
NTIS
Measuring Instruments; User Manuals (Computer Programs); Specifications; Calibrating

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.

20000015403 Air Force Office of Scientific Research, Bolling AFB, Washington, DC USA
Research Highlights, *Sep. - Oct. 1999*
Oct. 26, 1999; 5p; In English
Report No.(s): AD-A371406; AFRL-SR-BL-TR-99-0293; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
Two stories were included. Development of the lasers and the Success of the Airborne Laser Program. Research Highlights is published every two months by the Air Force Office of Scientific Research. This newsletter provides brief descriptions of AFOSR basic research activities.
DTIC
Airborne Lasers; Lasers; Research; Fabrication

20000018013 International Society for Optical Engineering, Bellingham, WA USA
Solid State Lasers, Volume 3682
Ustyugov, Vladimir I., Editor, International Society for Optical Engineering, USA; Jun. 26, 1998; 218p; In English, 22-26 Jun. 1998, Saint Petersburg, Russia; Sponsored by International Society for Optical Engineering, USA
Contract(s)/Grant(s): F61725-98-WE-027
Report No.(s): AD-A365098; EOARD-CSP-98-1023-2; No Copyright; Avail: CASI; A03, Microfiche; A10, Hardcopy
A resonator design strategy for high-power end-pumped solid-state lasers is described, which reduces the beam distortion due to thermally induced lens aberrations. The approach is based on a resonator design satisfying two criteria: firstly, the laser mode radius must be appreciably smaller than the pump beam radius, and secondly, the laser mode size must decrease with decreasing power (increasing focal length) of the thermal lens. Experimental results are presented for diode-bar-pumped Nd:YAG lasers confirming the validity of this approach. A simple technique, employing a single quarter-wave plate, for reducing the depolarization loss due to thermally-induced birefringence is also described. Using this approach, the depolarization loss for a diode-bar-pumped Nd:YAG laser operating at 946nm has been reduced from approx. 1.7% to less than 0.001%, resulting in 2.9W of linearly-polarized output for 14.3W of incident pump power.
DTIC
Solid State Lasers; Laser Applications; YAG Lasers; Neodymium Lasers

20000019586 Aerodyne Research, Inc., Billerica, MA USA
Diode-Pumped Nd:YAG/Cr(4+):YAG MicroChip-Laser System at 214.8 nm for the Detection of NO *Final Report, 1 Nov. 1996 - 30 Apr. 1999*
Wormhoudt, J.; Shorter, J. H.; Zayhowski, J. J.; Cook, C.; Jul. 30, 1999; 24p; In English
Contract(s)/Grant(s): DAAG55-97-C-0001
Report No.(s): AD-A370924; ARI-RR-1282; ARO-36327.1-RT-ST2; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
A passively Q-switched 214.8-nm Nd:YAG/Cr(4+):YAG microchip-laser system for the detection of NO was designed, constructed, and tested. The system uses the fifth harmonic of the 1.074-micrometers transition in Nd:YAG to detect NO at the

few-parts-per-billion level. A significant challenge was the development of an environmentally stable coating to provide the necessary discrimination between the 1.074-micrometers laser line and the stronger transition at 1.064 micrometers. The exact position of the fifth-harmonic frequency was determined using NO fluorescence excitation spectra to be 46556/cm. We observed a detection sensitivity for NO of about 15 ppb(v) in a simple, compact optical system. Earlier observations of SO2 imply a similar or better sensitivity for the current system, while green-light excitation of NO2 fluorescence yielded a detection limit of order 1 ppm(v). Applications of the laser system described here include explosives sensors based on detection of NO from thermal decomposition, and NO(x)/SO(x) monitors for trucks, aircraft and stationary sources.
DTIC
Nitrogen Oxides; Laser Pumping; Q Switched Lasers; Neodymium Lasers; YAG Lasers; Explosives Detection; Laser Applications

20000019638 California Inst. of Tech., Submillimeter Observatory, Pasadena, CA USA
A Submillimeter HCN Laser in IRC+10216
Schilke, P., Max-Planck-Inst. fuer Radioastronomie, Germany; Mehringer, D., California Inst. of Tech., USA; Menten, K., Max-Planck-Inst. fuer Radioastronomie, Germany; [1999]; 12p; In English
Contract(s)/Grant(s): NSF AST-96-15025
Report No.(s): Rept-1999-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We report the detection of a strong submillimeter wavelength HCN laser line at a frequency near 805 GHz toward the carbon star IRC+10216. This line, the J = 9 - 8 rotational transition within the (04 deg 0) vibrationally excited state, is one of a series of HCN laser lines that were first detected in the laboratory in the early days of laser spectroscopy. Since its lower energy level is 4200 K above the ground state, the laser emission must arise from the inner part of IRC+10216's circumstellar envelope. to better characterize this environment, we observed other, thermally emitting, vibrationally excited HCN lines and find that they, like the laser line, arise in a region of temperature approx. = 1000 K that is located within the dust formation radius; this conclusion is supported by the linewidth of the laser. The (04 deg 0), J = 9 - 8 laser might be chemically pumped and may be the only known laser (or maser) that is excited both in the laboratory and in space by a similar mechanism.
Author
Submillimeter Waves; Stellar Envelopes; Masers; Laser Spectroscopy; Hcn Lasers

20000020682 Harvard-Smithsonian Center for Astrophysics, Cambridge, MA USA
Laser-Polarized Noble Gas Magnetic Resonance
Walsworth, R. L., Harvard-Smithsonian Center for Astrophysics, USA; Albert, M. S., Brigham and Women's Hospital, USA; Cory, D. G., Massachusetts Inst. of Tech., USA; Hersman, F. W., New Hampshire Univ., USA; Hinton, D. P., Massachusetts General Hospital, USA; Hoffmann, D., Harvard-Smithsonian Center for Astrophysics, USA; Jolesz, F. A., Brigham and Women's Hospital, USA; Mair, R. W., Harvard-Smithsonian Center for Astrophysics, USA; Patz, S., Brigham and Women's Hospital, USA; Peled, S., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 590-592; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We are developing laser-polarized noble gas nuclear magnetic resonance (NMR) as a novel biomedical imaging tool for ground-based and eventually space-based application. This emerging multidisciplinary technology enables high-resolution gas-space magnetic resonance imaging (MRI)--e.g., of lung ventilation-as well as studies of tissue perfusion. In addition, laser-polarized noble gases (He-3 and Xe-129) do not require a large magnetic field for sensitive detection, allowing practical MRI at very low magnetic fields with a lightweight, low-power device.
Author
Magnetic Resonance; Imaging Techniques; Product Development; Helium Isotopes; Lasers

20000020947 Rensselaer Polytechnic Inst., Mathematical Sciences, Troy, NY USA
Regular and chaotic dynamics with applications in nonlinear optics *Final Report*
Kovacic, G.; Oct. 12, 1998; 10p; In English
Report No.(s): DE99-001416; DOE/ER/25154-T1; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

The following major pieces of work were completed under the sponsorship of this grant: (1) singular perturbation theory for dynamical systems; (2) homoclinic orbits and chaotic dynamics in second-harmonic generating, optically pumped, passive optical cavities; (3) chaotic dynamics in short ring-laser cavities; (4) homoclinic orbits in moderately-long ring-laser cavities; (5) finite-dimensional attractor in ring-laser cavities; (6) turbulent dynamics in long ring-laser cavities; (7) bifurcations in a model for a free-boundary problem for the heat equation; (8) weakly nonlinear dynamics of interface propagation; (9) slowly periodically

forced planar Hamiltonian systems; and (10) soliton spectrum of the solutions of the nonlinear Schroedinger equation. A brief summary of the research is given for each project.
NTIS
Nonlinear Optics; Perturbation Theory; Nonlinear Equations; Laser Cavities; Ring Lasers; Branching (Mathematics); Boundary Value Problems; Dynamical Systems

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.

20000017996 NASA Marshall Space Flight Center, Huntsville, AL USA
Marshall Space Flight Center High Speed Turbopump Bearing Test Rig
Gibson, Howard, NASA Marshall Space Flight Center, USA; Moore, Chip, NASA Marshall Space Flight Center, USA; Thom, Robert, NASA Marshall Space Flight Center, USA; [2000]; 1p; In English; 34th; 34th Aerospace Mechanisms Symposium, 10-12 May 2000, Greenbelt, MD, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The Marshall Space Flight Center has a unique test rig that is used to test and develop rolling element bearings used in high-speed cryogenic turbopumps. The tester is unique in that it uses liquid hydrogen as the coolant for the bearings. This test rig can simulate speeds and loads experienced in the Space Shuttle Main Engine turbopumps. With some internal modifications, the tester can be used for evaluating fluid film, hydrostatic, and foil bearing designs. At the present time, the test rig is configured to run two ball bearings or a ball and roller bearing and a hydrostatic bearing. The rig is being used to evaluate the lifetimes of hybrid bearings with silicon nitride rolling elements and steel races.
Author
Ball Bearings; Roller Bearings; Turbine Pumps; Test Facilities

20000019654 Boeing Co., Huntsville, AL USA
Pin Load Control Applied to Retractable Pin Tool Technology and Its Characterization
Olegoetz, P., Boeing Co., USA; [1999]; 1p; In English; 2nd; Friction Stir Welding, 6 Jun. 2000, Gothenburg, Sweden
Contract(s)/Grant(s): NASA Order H-31946-D; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Until the development of retractable pin tool (RPT) technology, friction stir welding (FSW) was limited to constant thickness joining of aluminum materials and the choices of keyhole elimination focused on traditional fusion and plug weld repair techniques. An invention, US Patent Number 5,893,507, ”Auto-Adjustable Pin Tool for Friction Stir Welding” assigned to NASA, demonstrated an approach to resolve these serious drawbacks. This approach brings forth a technique that allows the crater, or keyhole, to be closed out automatically at the end of the weld joint without adding any additional equipment or material. Also the probe length can be varied automatically in the weld joint to compensate for material thickness changes, such as, in a tapered joint. This paper reports the effects of pin extension and retraction rates in the weld joint and its correlation to weld quality. The investigation utilized a pin load-detecting device that was integrated in the Phase IIA RPT designed by Boeing for NASA/MSFC. The RPT modification provided pin load data that was accessed and used to eliminate root side indications and determine pin manipulation rates necessary to produce consistence homogeneous joints.
Author
Retractable Equipment; Pins; Friction Welding

20000020693 Allied-Signal Aerospace Co., Phoenix, AZ USA
Recent Progress in Air/Oil Seals Research at AlliedSignal
Ullah, M. Rifat, Allied-Signal Aerospace Co., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 79-92; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents Carbon Seal Blister Prevention Research from 1997-1998, in viewgraph form. The topics include: 1) Microstructure of Carbon-Graphite; 2) Modelling Current Blister Theories; 3) Blister Rig Development, for Repeatable Results; 4) Method Development: Blister Test and Damage Measurement; 5) ”Ranking” Tests for Various Carbon-Graphites; 6) Measurement of Key Properties; 7) Correlating Blister Damage to Revelant Variables; and Results To-Date.
CASI
Seals (Stoppers); Microstructure; Carbon; Graphite; Rupturing

20000020694 Concepts ETI, Inc., White River Jct, VT USA

Experimental and Numerical Results for a Liquid Hydrogen Turbopump with Seal Cavities

Oliphant, K. N., Concepts ETI, Inc., USA; Bhattacharyya, A., Concepts ETI, Inc., USA; Japikse, David, Concepts ETI, Inc., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 93; In English; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Effective sealing in secondary flow paths is critical to the performance of rocket turbopumps. It is important to be able to predict seal performance and the interaction of seal flows on the main flow in order for the designer to properly assess the impact of a particular seal design on the overall system performance. This paper presents the results of a series of Computational Fluid Dynamics (CFD) calculations of the First Stage SSME (Space Shuttle Main Engine) ATD (Advanced Technology Demonstration) LH2 (Liquid Hydrogen) Rocket Turbopump with seal cavities and compares the CFD results to experimental data over a range of operating points. It was seen that the CFD could predict the trends in the experimental data although the exact pressure drop through the seal cavity was not predicted. It was surmised that the discrepancy was due to the turbulence model that cannot capture the complex stress-strain fields that are present in the seal cavity. In addition, the CFD calculations indicated that the location of the seal cavity flow injection into the impeller eye region could be an important design criterion for both the seal cavity and the impeller. The pressure disturbance from the presence of the impeller leading edge caused the flow to locally reverse direction from the expected direction and went back into the seal cavity. More study is required to investigate this phenomenon and determine its effect on the system performance.

Author

Computational Fluid Dynamics; Sealing; Turbine Pumps; Liquid Hydrogen; Cavity Flow

20000020695 Edgerton, Germeshausen and Grier, Inc., Cranston, RI USA

Seal Technology Development at EG/G Engineered Products

England, Ray, Edgerton, Germeshausen and Grier, Inc., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 95-112; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents Seal Technology Development at EG/G Engineered Products in viewgraph form. The topics include: 1) Liftoff Geometries; 2) Gas Face Seal Theory; 3) Test Results; 4) High Angular Compliance Gas Seal; 5) Mechanical Properties Prediction: Spring Rate; ED shift; 6) High Cycle Fatigue Design; 7) Low Cycle Fatigue Design; 8) Historical Development; 9) Predicted Leakage; 10) Design Comparison; 11) Aerospace Test Rig; 12) Standard and Advanced Designs; and Bush Seal Technology.

CASI

Seals (Stoppers); Technology Utilization; Design Analysis

20000020696 Stein Seal Co., Kulpsville, PA USA

Seal Development at Stein Seal Company

McNickle, Alan D., Stein Seal Co., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 113-161; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents Seal Development Programs in viewgraph form. The topics include: 1) Hydrodynamic Circumferential Seals (Gas Seals, Oil Seals); 2) Hydrostatic Face Seals (Aspirating Seal, Stepped Face Seal); and 3) Intershaft Seals (Hydrostatic Face Seal).

CASI

Seals (Stoppers); Hydrostatics; Hydrodynamics

20000020697 FlowServe Corp., Kalamazoo, MI USA

Flowserve Corporation Fluid Sealing Division

Adams, Bill, FlowServe Corp., USA; Artiles, Tony, FlowServe Corp., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 163-175; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a general overview of fluid sealing. The topics include: 1) Company Overview (Corporation Structure, Merger, Fluid Sealing Division); 2) Seal Developments; and 3) Advanced Hybrid Brush Seal Design (Advantages, Optimization of Design, Performance Summary).

CASI

General Overviews; Brush Seals; Design Analysis; Optimization

20000020698 B and C Engineering Associates, Inc., Akron, OH USA

Advances in the Hybrid Floating Brush Seal Nozzle Joint Locations

Lattime, Scott, B and C Engineering Associates, Inc., USA; Braun, J., B and C Engineering Associates, Inc., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 177-204; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the Hybrid Floating Brush Seal in viewgraph form. The topics include: 1) Background (The Hybrid Floating Brush Seal, The Room Temperature Test Rig, Brush Seal Design); 2) Summary (Problems, Solutions, Achievements); 3) Experimental Results (Leakage, Film Thickness); and 4) Direction of Work (Goals, Tasks).

CASI

Brush Seals; Position (Location); Design Analysis; Hybrid Structures

20000020700 NASA Glenn Research Center, Cleveland, OH USA

Tribological Tuft Testing Candidate Brush Seal Materials

DellaCorte, Chris, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 219-234; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a tribological tuft test method of candidate brush seal materials in viewgraph form. The goals of the research are: 1) to develop test method to tribologically brush seal materials; 2) to evaluate materials to identify potential improvements and trends; and 3) Guide seal material development and selection.

CASI

Tribology; Brush Seals; Turbine Engines; High Temperature Tests

20000020701 Mohawk Innovative Technology, Inc., Albany, NY USA

Advanced Bearings/Seals for General Aviation Engines

Walton, James F., II, Mohawk Innovative Technology, Inc., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 235-242; In English; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents advanced bearings/seals for general aviation engines. The objective is to: 1) Develop preliminary bearings/seals for W.I.G.A (Williams International General Aviation) engine; 2) Enhance/Expand existing compliant foil, and analysis tools for seals; 3) Select materials and coatings (commercialization of NASA PS 304 coatings); and 4) Validate analysis through experiments. This paper is presented in viewgraph form.

CASI

General Aviation Aircraft; Seals (Stoppers); Foil Bearings; Mathematical Models; Gas Turbine Engines

20000020702 Boeing Co., Rocketdyne Propulsion and Power, Canoga Park, CA USA

Rocket Turbomachinery Shaft Seals

Keba, John E., Boeing Co., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 243-257; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents Rocket Turbomachinery Shaft Seals in viewgraph form. The topics include: 1) Operating Environments (Fluids and fluid conditions, Various stages of turbopump operation); 2) Design Issues (Inter-Propellant-Seal (IPS) Systems, ”Lift-off” Seal Systems); and 3) Technology Development Needs.

CASI

Turbomachinery; Turbine Pumps; Seals (Stoppers); Turboshafts; Space Shuttle Main Engine

20000020703 General Electric Co., Research and Development, Schenectady, NY USA

Advanced Seals for GE Industrial Gas Turbine Applications

Dinc, S., General Electric Co., USA; Reluzco, G., General Electric Co., USA; Turnquist, N. A., General Electric Co., USA; Zhou, M., General Electric Co., USA; Kerber, O., General Electric Co., USA; Brunner, F., General Electric Co., USA; Crum, G., General Electric Co., USA; Stuck, A. E., General Electric Co., USA; Cromer, R. H., General Electric Co., USA; Marks, P. T., General Electric Co., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 259-278; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents Advanced Seals for G.E. (General Electric) industrial Gas Turbine Applications. The topics include: 1) 7EA Gas Turbine Cross Section; 2) Stationary Seal Applications; 3) Cloth Seal at Turbine Hot Gas Path; 4) Rotational Seals: Brush Seal Development; 5) Brush Seal Testing: Fundamentals; 6) Brush Seal Design Process for Turbine Applications; 7) Interstage

Seals: Leakage and Hysterisis and 8) Interstage Seals: Wear Test and Field Pressure Data. This paper is presented in viewgraph form.
CASI
Brush Seals; Gas Turbines; Mechanical Properties; Design Analysis

20000020704 General Electric Co., Schenectady, NY USA
Challenges in Hydrogen Sealing for Generators
Bagepalli, Bharat, General Electric Co., USA; Aksit, Mahmut, General Electric Co., USA; Mayer, Rob, General Electric Co., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 279-284; In English; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Hydrogen has seven times the heat-extraction capacity of air. The use of hydrogen for cooling large turbo-generators substantially reduces their size compared with using air. The objective of this paper is to reduce H2 consumption by 50% and manage oil seals. Brush Seals will be used and a smaller pump will be used to reduce oil flow. This paper is presented in viewgraph form.
CASI
Hydrogen; Brush Seals; Turbogenerators

20000020705 Siemens Westinghouse Power Corp., Orlando, FL USA
Advanced Seal Development for Siemens Westinghouse Combustion Turbines
Chupp, Raymond E., Siemens Westinghouse Power Corp., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 285-307; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Several efforts are in progress at Siemens Westinghouse to develop advanced sealing for large utility industrial gas turbine engines (combustion turbines). Much of this effort focuses on transitioning aero gas turbine technology to combustion turbines. Brush seals, film riding face and circumferential seals, and other dynamic and static sealing devices are replacing labyrinth and other seals. For combustion gas turbines, advanced sealing can significantly reduce leakage flows because of the enormous size of the components and the relatively constant operating conditions. Challenges include: extremely long operating lives; infrequent but large position excursions; difficulty in coating or treating larger components; plus maintenance, installation, and durability requirements. The development includes rig testing and engine validation of prototype designs. This effort is part of the Advance Turbine Systems (ATS) engine development being done under a cooperative agreement between Siemens Westinghouse and the US Department of Energy, Office of Fossil Energy.
Author
Gas Turbine Engines; Sealing; Combustion; Systems Engineering; Design Analysis

20000020758 Idaho National Engineering Lab., Idaho Falls, ID USA
Fracture Processes in Mismatched Weldments
Yoder, T. S.; Reuter, W. G.; Lloyd, W. R.; Jun. 01, 1999; 8p; In English; 1999 SEM Annual Conference on Theoretical, Experimental, and Computational Mechanics, 7-9 Jun. 1999, Cincinnati, OH, USA
Report No.(s): DE00-007721; INEEL/CON-99-00379; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Microstructural heterogeneity and residual stresses make fitness-for-service assessments of structural components containing weldments difficult to perform. Concerns and problems specific to mismatched weldments are addressed and discussed.
NTIS
Welded Joints; Structural Design; Fracturing; Residual Stress

20000020831 Rolls-Royce Ltd., Coventry, Industrial and Marine Gas Turbines, West Midlands, UK
Advances in a Gas Turbine System for Ship Propulsion
Parker, M. L., Rolls-Royce Ltd., Coventry, UK; MacLeod, P. K., Rolls-Royce Ltd., Coventry, UK; Coulson, M., Rolls-Royce Ltd., Coventry, UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 2-1 - 2-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

For thirty years, the obvious advantages of gas turbines in marine propulsion systems have been fully exploited by many of the world's navies. Conventional naval gas turbine propulsion systems utilize cruise engines (either a diesel or a gas turbine) to provide low speed fuel economy together with a boost gas turbine to provide the high power for top speeds. Fuel efficiency improvements in marine gas turbines have generally progressed in line with aero engine technology advancement. The potential

for substantial fuel savings in the future is available through the adoption of complex cycle engines. An intercooled and recuperated (ICR) gas turbine, known as the RM60, went to sea in HMS Grey Goose (the world's first warship to rely entirely upon gas turbine propulsion) in 1953 and continued in service for over 4 years. The RM60, however was not viable for long term production due to its size and technical complexity. The only advanced cycle marine gas turbine currently in development is the intercooled and recuperated WR-21, the development of which is being funded by the USA Navy, the Royal Navy, and French Navy. The highly efficient WR-21, rate at 25.2 MW (ISO), is derived from the Rolls-Royce aero RB211 and latest Trent family of jet engines components being suitably adapted for marine environment. In addition modifications are necessary to integrate the heat exchangers and hot-end variable geometry in an effective manner. The imminent re-introduction of an advanced cycle marine gas turbine will radically improve fuel consumption by up to 30% when averaged over a typical naval duty cycle. This fuel saving, in conjunction with current condition-based maintenance techniques, engine modularization and the potential for retrofit of an ultra-low emission combustion system should cause a re-examination of the dominance of the diesel in many commercial marine applications. The combustion system requirements for the ICR cycle differ significantly from those of a conventional gas turbine, both in terms of aerodynamic and thermal characteristics of the cycle and also the overall system architecture. This paper summarizes the aerodynamic and mechanical design, rig verification, and development engine experience on the WR-21 combustion system to the present time.
Derived from text
Marine Propulsion; Propulsion System Configurations; Propulsion System Performance; Fuel Consumption; Gas Turbine Engines; Engine Design; Engine Parts

20000020832 Naval Air Systems Command, Patuxent , MD USA
Technical Challenges Associated with the Development of Advanced Combustion Systems
VanErp, Christopher A., Naval Air Systems Command, USA; Richman, Marcus H., Naval Air Systems Command, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 3-1 - 3-5; In English; See also 20000020829; Copyright Waived; Avail: CASI; A01, Hardcopy; A06, Microfiche

The U.S. Navy, as a participant in the USA' Integrated High Performance Turbine Engine Technology (IHPTET) initiative, is dedicated to increasing aircraft engine performance to satisfy the propulsion requirements of future Navy aircraft. This is accomplished by identifying the propulsion requirements, in terms of performance and total cost, for specific Navy aircraft. The required engine technology advances are then broken down into specific engine component technology objectives. Advanced technology is then developed on the component level. Once an appropriate level of readiness is reached, the components are then assemble into an engine for an overall advanced propulsion system demonstration. Technologies from this demonstrator engine are then made available to development engine programs, such as the Joint Strike Fighter (JSF), for further development and eventual transition to production engine programs. The figure of merit used to measure performance is engine thrust/weight ratio. The role of the combustor in this endeavor is to provide the necessary temperature rise to increase core engine output. This drives the combustor to operate at higher fuel/air ratios which in turn drives a larger portion of the combustor volume to operate at or near stoichiometric conditions. Combustor operation at these levels must be achieved with an eye to numerous other parameters such as durability, weight, cost and emissions. The technical challenges presented in attempting to meet these oh objectives simultaneously are the subject of this paper.
Derived from text
Aircraft Engines; Combustion Chambers; Engine Design; Gas Turbine Engines; Propulsion

20000020836 United Technologies Research Center, Aeromechanical, Chemical and Fluid Systems, East Hartford, CT USA
Measurement of Spray/Acoustic Coupling in Gas Turbine Fuel Injectors
Anderson, Torger J., United Technologies Research Center, USA; Kendrick, Donald W., United Technologies Research Center, USA; Cohen, Jeffrey M., United Technologies Research Center, USA; Rosfjord, Thomas J., United Technologies Research Center, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 9-1 - 9-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

A diagnostic to measure the acoustic coupling of air flow with a fuel injector spray has been developed and tested. The instrument measures the mass of fuel within a plane of the spray using planar laser-induced fluorescence. The signal is monitored continuously to measure mass flow fluctuations during acoustic excitation of the flow. A comparison with the acoustic signal provides a measure of the response of the spray to acoustic excitation for a given nozzle design. This paper describes the approach

to acquiring a planar-integrated time-dependent signal for response measurements. Results for several nozzle designs are also presented.
Author
Fuel Injection; Air Flow; Gas Turbine Engines; Nozzle Design; Acoustic Coupling; Fuel Sprays; Laser Induced Fluorescence; Optical Measurement

20000020837 Rolls-Royce Ltd., Derby, UK
Soot and Radiation Modelling in Gas Turbine Combustion Chambers
Brocklehurst, H. T., Rolls-Royce Ltd., UK; Moss, J. B., Cranfield Univ., UK; Hurley, C. D., Defence Evaluation Research Agency, UK; Priddin, C. H., Rolls-Royce Ltd., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 10-1 - 10-13; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The processes of soot formation and burn-out in liquid-fuelled combustors at practically relevant operating conditions remain poorly understood despite their importance in relation to emissions and, through their influence on radiation, to liner durability and life. The development of simplified theoretical models, necessitated by the underlying physical and chemical complexity, incorporates substantial empiricism and is particularly sensitive to scaling and the calibration of model parameters. This is particularly evident in the application of these models to realistic geometries. Previous post processed soot calculations in gas turbine combustion chambers neglecting the effects of radiation have found that predicted soot levels are an order of magnitude too high in comparison to measurements at 6 bar. The situation is worse for full power conditions, where the increased pressure (over 40 bar) can lead to such large amounts of soot being produced, that more carbon is converted to soot than is available in the fuel. In addition, the soot models are not able to capture the measured level of oxidation between the the primary zone and the combustor exit. This paper describes further developments in the modelling of the sooting processes, where the rate of oxidation is captured more accurately and the effects of radiation are treated more completely. The soot is modelled using a flamelet-based approach employing computations of a kerosene laminar counter-flow flame which incorporates detailed reaction kinetics, and radiation heat loss calculated using the Discrete Transfer Radiation Model. The effects of radiation on both the soot chemistry and the flow pattern (via density changers) are modelled by using a family of flamelets each with a different amount of heat loss. The most appropriate flamelet is selected on the basis of the local computed enthalpy, including heat loss due to radiation. Comparisons are presented between model prediction and sampled measurements from a gas turbine combustor at 6 bar Uncertainties remain in relation to the effective soot aerosol surface area and hence the rate of soot hum-out. Encouraging progress is reported on the coupling between soot production and radiation heat transfer for purposes of wall heat flux production.
Author
Gas Turbine Engines; Mathematical Models; Radiation Effects; Combustion Chambers; Soot; Emission

20000020848 National Aerospace Lab., VH Dept., Amsterdam, Netherlands
Modeling the Effects of Operating Conditions and Alternative Fuels on Gas Turbine Performance and Emissions
Visser, W. P. J., National Aerospace Lab., Netherlands; Kluiters, S. C. A., Technische Univ., Netherlands; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 21-1 - 21-11; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

With the increasing attention to gas turbine exhaust gas pollution, a need has emerged to assess effects of a variety of operational variables on the emission levels. An effective approach to address this need is to integrate combustor emission models in gas turbine performance models. NLR's generic gas turbine performance simulation environment (GSP) has therefore been extended with a number features for accurate analysis of these effects on the major exhaust gas emissions NO, CO, UHC and Smoke. First, GSP's gas model has been extended to include a detailed description of gas composition including the particular emission species. Second, a new generic multi-reactor combustor model has been developed for detailed modeling of the processes in a combustor. The combustor model is set up by defining a number of reactors modeling combustion, mixing. steam/water-injection and their effects on emission formation using semi-empirical models for the reaction kinetics. Fuel properties and composition can be specified in detail, enabling analysis of effects of alternative fuels on gas turbine engine performance and emissions. Preliminary validation results with the multi-reactor combustion model corresponded with measured emission data and with expected operating condition effects on emissions. With the NOx model best accuracy was obtained. The accuracy of particularly the CO, UHC and Smoke formation models may he improved by adapting the multi-reactor model to allow for modeling of effects such as film cooling and other effects not covered by a one-dimensional model. The current generic

multi-reactor combustor module will be used for easy implementation of improved emission models in the future. This work will also involve extensive validation using detailed engine. combustor and emission data.
Author
Combustion; Gas Turbine Engines; Combustion Physics; Mathematical Models; Exhaust Emission; Exhaust Gases; Combustion Chambers

38
QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

20000020959 National Renewable Energy Lab., Golden, CO USA
Silicon Ingot Lifetime Tester for Industrial Use
Matthus, A.; Mihalik, G.; Oct. 22, 1998; 6p; In English; National Center for Photovoltaics Program Review Meeting, 8-11 Sep. 1998, Denver, CO, USA
Report No.(s): DE00-007130; NREL/CP-590-25681; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

A specially designed lifetime measurement instrument has been developed to characterize silicon ingots before they are subjected to expensive slicing and solar-cell processing, thereby saving needless processing costs of inferior materials in a solar-cell production line. The instrument uses the direct-current photoconductance decay (DC-PCD) method for linear detection of the transient photoconductance signal and localized probing / illumination for necessary sensitivity on low resistivity and large samples. The instrument also has a compact and high-power laser diode as the light source, data averaging capability, a pneumatic ingot transport and probe positioning mechanism, and a user-friendly graphical interface for data acquisition / lifetime calculation / data storage / hardcopy for factory-floor use with quick turnaround. A 3- dimensional finite-element analysis indicates that the as-cut surface finish is adequate for measuring the bulk lifetime on the order of 50 ms or less. Measurement repeatability and clear distinction among different grades of feedstock materials have been demonstrated.
NTIS
Solar Cells; Silicon; Carrier Lifetime; Measuring Instruments; Ingots; Surface Finishing

20000021026 Minnesota Univ., Dept. of Civil Engineering, Minneapolis, MN USA
Acoustic Emission Equipment for Infrastructure Monitoring ***Final Report***
Shield, C. K.; Apr. 1999; 20p; In English
Report No.(s): PB99-172637; MN/RC-1999-18; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This project details the development and evaluation of an acoustic emission (AE) system for monitoring large scale structures, both in the lab and in the field. The system consists of acoustic emission sensors, preamplifiers, filers, an AE monitor, and a digital oscilloscope. The system has been applied successfully to both steel and concrete structures and used to detect brittle fracture and low-cycle fatigue failures in welded steel joints and crack propagation in cover-plated rolled bridge girders, in the field and in the laboratory. The AE system detected initial cracking during the flexural crack testing of two high-strength concrete prestressed bridge girders. The acoustic emission monitoring of bond tests also provided insight into the behavior of the bond between glass fiber reinforced polymer rebar and concrete.
NTIS
Acoustic Emission; Steel Structures

39
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 structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

20000015367 Texas Univ., San Antonio, TX USA
Dynamic Lateral Earth Pressures on Underground Structures: Predicting Stresses Due to Impact Loadings
VanDeWalle, Curt A.; Nov. 08, 1999; 33p; In English
Report No.(s): AD-A371308; AFIT-FY99-432; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The underground detonation of an explosive device produces shock waves such as Primary waves (P-waves) and Secondary (or Shear) waves (S-waves). These waves cause buildup of pressures within a soil medium. These pressures have the capability of rendering destructive forces on underground structures, and consequently represent life threatening danger. Understanding these forces can aid in the design of underground structures to withstand such pressures, or alternatively, to design munitions which will render the maximum destructive power on underground structures when dropped at a predefined depth and distance from the structure. A conceptual representation of dynamic lateral earth pressures generated from an earth penetrating munition is shown.
DTIC
Underground Explosions; Impact Loads; Destruction; Detonation; Dynamic Pressure

20000017929 NASA Glenn Research Center, Cleveland, OH USA
Quantification of Processing Effects on Filament Wound Pressure Vessels
Aiello, Robert A., Modern Technologies Corp., USA; Chamis, Christos C., NASA Glenn Research Center, USA; December 1999; 20p; In English
Contract(s)/Grant(s): RTOP 523-22-13
Report No.(s): NASA/TM-1999-209434; E-11899; NAS 1.15:209434; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A computational simulation procedure is described which is designed specifically for the modeling and analysis of filament wound pressure vessels. Cylindrical vessels with spherical or elliptical end caps can be generated automatically. End caps other than spherical or elliptical may be modeled by varying circular sections along the x-axis according to the C C! end cap shape. The finite element model generated is composed of plate type quadrilateral shell elements on the entire vessel surface. This computational procedure can also be sued to generate grid, connectivity and material cards (bulk data) for component parts of a larger model. These bulk data are assigned to a user designated file for finite element structural/stress analysis of composite pressure vessels. The procedure accommodates filament would pressure vessels of all types of shells-of-revolution. It has provisions to readily evaluate initial stresses due to pretension in the winding filaments and residual stresses due to cure temperature.
Author
Filament Winding; Pressure Vessels; Residual Stress; Stress Analysis; Structural Analysis

20000017965 Colorado Univ., Boulder, CO USA
A New Merit Function for Evaluating the Flaw Tolerance of Composite Laminates, Part 2, Arbitrary Size Holes and Center Cracks
Martin, Mikulas M., Jr., Colorado Univ., USA; Sumpter, Rod, Colorado Univ., USA; January 2000; 46p; In English
Contract(s)/Grant(s): NAG1-1642; RTOP 522-11-41
Report No.(s): NASA/CR-2000-209559/PT2; NAS 1.26:209559/PT2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In a previous paper, a new merit function for determining the strength performance of flawed composite laminates was presented. This previous analysis was restricted to circular hole flaws that were large enough that failure could be predicted using the laminate stress concentration factor. In this paper, the merit function is expanded to include the flaw cases of an arbitrary size circular hole or center crack. Failure prediction for these cases is determined using the point stress criterion. An example application of the merit function is included for a wide range of graphite/epoxy laminates.
Author
Stress Concentration; Laminates; Failure Analysis; Holes (Mechanics); Nondestructive Tests

20000018020 NASA Glenn Research Center, Cleveland, OH USA
Probabilistic Assessment of Fracture Progression in Composite Structures
Chamis, Christos C., NASA Glenn Research Center, USA; Minnetyan, Levon, Clarkson Univ., USA; Mauget, Bertrand, Clarkson Univ., USA; Huang, Dade, Alpha Star Corp., USA; Addi, Frank, Alpha Star Corp., USA; December 1999; 22p; In English; 1998 Aircraft Structural Integrity Program Conference, 1-3 Dec. 1998, San Antonio, TX, USA
Contract(s)/Grant(s): RTOP 523-22-13
Report No.(s): NASA/TM-1999-209269; E-11719; NAS 1.15:209269; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes methods and corresponding computer codes that are used to evaluate progressive damage and fracture and to perform probabilistic assessment in built-up composite structures. Structural response is assessed probabilistically, during progressive fracture. The effects of design variable uncertainties on structural fracture progression are quantified. The fast

probability integrator (FPI) is used to assess the response scatter in the composite structure at damage initiation. The sensitivity of the damage response to design variables is computed. The methods are general purpose and are applicable to stitched and unstitched composites in all types of structures and fracture processes starting from damage initiation to unstable propagation and to global structure collapse. The methods are demonstrated for a polymer matrix composite stiffened panel subjected to pressure. The results indicated that composite constituent properties, fabrication parameters, and respective uncertainties have a significant effect on structural durability and reliability. Design implications with regard to damage progression, damage tolerance, and reliability of composite structures are examined.
Author
Composite Structures; Polymer Matrix Composites; Fracturing; Damage; Applications Programs (Computers); Crack Propagation; Dynamic Response

20000018021 Army Engineer Waterways Experiment Station, Engineer Research and Development Center, Vicksburg, MS USA
Development of a Constitutive Model for Numerical Simulation of Projectile Penetration into Brittle Geomaterials ***Final Report***
Cargile, J. D.; Sep. 1999; 227p; In English
Report No.(s): AD-A371291; WES/TR/SL-99-11; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche
A nonlinear, inelastic fracture model for brittle geomaterials has been developed for simulating the response of these materials to high-velocity projectile penetration. Laboratory mechanical property experiments show a transition in the shearing response for these materials from brittle at low pressures to ductile at high pressures. The model has the underlying assumption that the shearing response can be resolved into a brittle cohesive component and a ductile frictional component At low pressures, the cohesive component controls the behavior and the material response is brittle. As pressure increases, the cementing bonds that hold the aggregate particles together are broken and the contribution of the cohesive component decreases while the contribution of the frictional component increases. Once the bonds are completely broken, the material response is determined only by the ductile frictional component. The model response agreed well with the results from various quasi-static triaxial experiments on concrete samples. The model is implemented into a finite-element code and used to simulate high-velocity projectile penetration events. A series of laboratory penetration and perforation experiments were conducted and used to evaluate the model within the finite-element wave propagation code. Penetration experiments were conducted by launching robust steel projectiles into semi-infinite concrete targets to obtain depth of penetration and crater profiles at impact velocities ranging from 277 to 800 m/s. Perforation experiments were conducted by launching robust steel projectiles at 313 m/s into concrete slabs measuring 127 to 284 mm thick to obtain exit velocity and crater profiles. High-speed movies of the impact and exit faces of the targets showed the evolution of surface damage during the perforation event. Depth of penetration and exit velocity from simulations of the penetration and perforation experiments agree well with the experiment results.
DTIC
Brittleness; Models; Numerical Analysis; Penetration; Structural Stability; Concretes; Fracturing

20000019582 Norwegian Defence Research Establishment, Kjeller, Norway
Design and Modelling of Sandwich Plate for Drop Test
Jensen, Alf Egil, Norwegian Defence Research Establishment, Norway; Berg, Jan Erik, Norwegian Defence Research Establishment, Norway; Taby Jon, Norwegian Defence Research Establishment, Norway; Sep. 28, 1999; 38p; In English; Original contains color illustrations
Contract(s)/Grant(s): FFIE Proj. 711/116
Report No.(s): FFI/RAPPORT-99/04777; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The report gives an account of the considerations and analyses that were carried out before the manufacture of a sandwich plate for a drop test. The plate was to resemble as closely as possible a wet deck panel on the new Norwegian Fast Patrol Boat, but as fibre reinforced composites are very difficult to down-scale a careful weighing of physical strength and dimensions was necessary. Both static and dynamic Finite Element analyses were performed.
Author
Design Analysis; Models; Drop Tests; Sandwich Structures

20000019668 Oak Ridge National Lab., Grand Junction, CO USA
Stress Analysis of Laminated Composite Cylinders Under Non-Axisymmetric Loading
Starbuck, J. M.; Oct. 26, 1999; 12p; In English; 31st; 31st International SAMPE Conference, Chicago, IL, October 26-30, 1999, 26-30 Oct. 1999, Chicago, IL, USA
Report No.(s): DE00-009069; ORNL/CP-103788; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The use of thick-walled composite cylinders in structural applications has seen tremendous growth over the last decade. Applications include pressure vessels, flywheels, drive shafts, spoolable tubing, and production risers. In these applications, the geometry of a composite cylinder is axisymmetric but in many cases the applied loads are non-axisymmetric and more rigorous analytical tools are required for an accurate stress analysis. A closed-form solution is presented for determining the layer-by-layer stresses, strains, and displacements and first-ply failure in laminated composite cylinders subjected to non-axisymmetric loads. The applied loads include internal and external pressure, axial force, torque, axial bending moment, uniform temperature change, rotational velocity, and interference fits. The formulation is based on the theory of anisotropic elasticity and a state of generalized plane deformation along the axis of the composite cylinder. Parametric design trade studies can be easily and quickly computed using this closed-form solution. A computer program that was developed for performing the numerical calculations is described and results from specific case studies are presented.
NTIS
Stress Analysis; Bending Moments; Structural Analysis; Structural Design; Laminates; Composite Materials

20000020752 Sandia National Labs., Albuquerque, NM USA
Experiments of Cercom SiC Under Impact
Chhabildas, L. C.; Furnish, M. D.; Holland, K. G.; Reinhart, W. D.; Jun. 23, 1999; 6p; In English; Shock Compression of Condensed Matter (SHOCK99), 27 Jun. - 2 Jul. 1999, Snowden, UT, USA
Report No.(s): DE00-008452; SAND99-0874C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Gas gun experiments combined with velocity interferometric techniques have been used to experimentally determine the loading behavior of sleeved Cercom silicon carbide rods. Graded density materials have been used as impactors, thereby eliminating the tension states generated by the radial stress components during the loading. phase. Results of these experiments demonstrate that the time- dependent stress pulse generated during impact allows an efficient transition from the initial uniaxial strain loading to a uniaxial stress state as the stress pulse propagates through the rod allowing access to intermediate loading rates. Intermediate loading rates obtained in this configuration lie between split Hopkinson bar and shock-loading techniques.
NTIS
Silicon Carbides; Interferometry; Axial Strain; Loading Rate

20000020775 Technische Hogeschool, Dept. of Aerospace Engineering, Delft, Netherlands
Effect of Cross-Coupling on the Buckling Load of Imperfect Anisotropic Cylindrical Shells under Rigorous Boundary Conditions: A Correction for the 'Cross-Coupling Effect' in COLLAPSE
Smits, G. N.; Aug. 1998; 156p; In English
Report No.(s): PB2000-100739; Memo-M-851; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy
The buckling of shells under rigorous boundary conditions has been the subject of studies for years. However, it was only recently found, that for asymmetrically layed-up composite shells the Donnel shell equations, when combined with an Airy Stress function, do not give correct results if boundary conditions restrict the displacements in axial and circumferential direction. This is caused by an inadequate mathematical formulation of these boundary conditions. If the displacements in axial and circumferential direction are prescribed correctly, induced stress-resultants occur for asymmetric anisotropic cylindrical shells. This effect is referred to as Cross-Coupling.
NTIS
Cross Coupling; Buckling; Loads (Forces); Anisotropic Shells; Boundary Conditions; Correction; Aerospace Engineering

20000020787 Tokyo Univ., Japan
Creep and Fracture of Engineering Materials and Structures
Sakuma, T., Tokyo Univ., Japan; Yagi, K., Tokyo Univ., Japan; Nov. 15, 1999; 857p; In English; 8th; Creep and Fracture of Engineering Materials and Structures, 1-5 Nov. 1999, Tsukuba, Japan; Sponsored in part by Iketani Science and Technology Foundation
Contract(s)/Grant(s): F62562-99-M-9224
Report No.(s): AD-A370828; AOARD-CSP-99-12; No Copyright; Avail: CASI; A10, Microfiche; A99, Hardcopy
Sampling of proceedings includes the following: (1) "Recent Developments in the Analysis of Creep Rupture Data"; (2) "Creep Crack Growth in Nearly Fully-Lamellar Gamma TiA1 Alloys"; (3) "Research of Welding Effect on Creep Damage of High Temperature Furnace Tubes"; (4) "The Reversibility of Creep Strain at Low Stresses and Low Temperatures"; (5) "Deformation

Behavior of 7475 Aluminum Alloy at High Temperatures"; and (6) "Creep of Reinforced and Unreinforced AZ91 Magnesium Alloy".
DTIC
Conferences; Creep Properties; Fracturing; Aluminum Alloys; Fracture Mechanics; Structural Analysis

20000021072 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Advances in Structural Loadflow Visualisation and Applications to Optimal Shapes
Waldman, W.; Heller, M.; Rose, L. R.; Oct. 1999; 68p; In English
Report No.(s): AD-A371759; DSTO-RR-0166; DODA-AR-011-110; Copyright; Avail: Defense Technical Information Center (DTIC)

Currently there is no generally accepted procedure for calculation of structural loadpaths, which would show how remote loads are equilibrated through a structure and could provide insight into how well a structure is performing its intended load-carrying functions. Kelly and Elsley have recently proposed a method for computing loadflow orientations and loadpaths using finite element results, which is based on iterative solutions of non-linear equations. In this paper, we have enhanced their theoretical formulation and general procedure by deriving explicit expressions for computing loadflow orientations. The new equations produce more accurate loadflow orientations compared to the prior approach and improve the fidelity of calculated loadpaths. In a series of benchmark problems, we have investigated non-optimal and optimal holes in plates using loadflow visualisation to identity their key features. We found that recirculation is apparent for non-optimal hole shapes, whereas no recirculation zone is present for optimal shapes. Although very highly refined finite element meshes were utilized, the implications are that even more refined meshes are required to fully capture the complex behaviour that exists in recirculation zones. The removal of the recirculation zone for a non-optimal shape leads to a better shape, but the improvement in peak stress is insignificant. The calculation of loadflow orientations using the new equations is simple, and could be used with any finite element analysis code, while a plotting package is required to display loadpaths. Loadflow visualisation is a powerful tool for use by structural designers to improve their understanding of structural performance, the application of which can potentially result in worthwhile improvements in structural efficiency.
DTIC
Flow Visualization; Structural Analysis; Load Distribution (Forces)

42
GEOSCIENCES (GENERAL)

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

20000017918 Alabama Univ., Huntsville, AL USA
Evaluation of Results of SIR-C/X-SAR Missions (STS 59 and STS 68) for Earth Science Applications
Cruise, James F., Alabama Univ., USA; Spacelab Science Results Study; Aug. 18, 1999; Volume 1, pp. 89-113; In English; See also 20000017914; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The dual Spaceborne Imaging Radar-C (SIR-C)/X-band Synthetic Aperture Radar (X- SAR) was flown aboard the Shuttle Endeavour during the April and October 1994 missions (STS 59 and STS 68). The SIR-C system records data at both L (23.5 cm) and C (5.8 cm) wavelengths (1.25 GHz and 5.3 GHz frequencies, respectively) with full polarimetric scattering; while the X-SAR is capable of recording data in the X-band (3.1 cm, 10 GHz) with copolar polarization only. The integrated system records data simultaneously at incidence angles ranging from 15 - 60 deg with image resolution varying from 10 to 50 m depending on system configuration. The SIR-C/X-SAR is the most advanced airborne imaging radar system ever flown in earth orbit in comparison to satellite mounted instruments such as the European Remote Sensing Satellites (ERS-1,2), the Japanese Remote Sensing Satellite (JERS-1) or the Canadian RADARSAT. Current satellite systems are limited in number of channels, polarization, incidence angle and spatial resolution. For example, the ERS-1, launched in 1991 records data in the C-band, copolar (VV) configuration only with a spatial resolution of 50 km and an incidence angle of 23 deg, while the JERS- 1 records observations in the L-band copolar (HH) configuration at an incidence angle of 35 deg and a spatial resolution of 80 km. In contrast, the

SIR-C/X-SAR is capable of numerous combinations of frequency/polarization configurations over a range of incidence angles and thus can produce enhanced images for a wide variety of earth science applications.
Author
Environmental Monitoring; Evaluation; Data Acquisition; Synthetic Aperture Radar; C Band; Image Resolution; Remote Sensing

20000020893 Geological Survey, Water Resources Div., Sacramento, CA USA
Biological, Habitat, and Water Quality Conditions in the Upper Merced River Drainage, Yosemite National Park, California, 1993-1996
Brown, L. R.; Short, T. M.; 1999; 70p; In English
Report No.(s): PB2000-101833; USGS/WRI-99-4088; No Copyright; Avail: National Technical Information Service (NTIS)
The report summarizes results of the following studies that were conducted in the Park from 1993 to 1996. First, NAWQA sampling at Happy Isles and at the Merced River at Pohono Bridge, was undertaken to monitor long-term trends in the fish community, benthic invertebrate community, benthic algae community, and stream habitat. Second, a survey of algae, invertebrates, fish, habitat, and water quality of the upper Merced River drainage (above McClure Reservoir) was done in 1994. Third, special study of benthic algae, habitat, and water quality of the Merced River within Yosemite Valley in 1995 was carried out to determine whether there were any effects of human activities on the ecosystem. Fourth, a special study of algae, invertebrates, and habitat was done in 1996 in Yosemite Valley to provide baseline data for assessment of the effects f stream bank improvements on aquatic biota.
NTIS
Habitats; Water Quality; Drainage

20000020932 Geological Survey, Reston, VA USA
Diagenesis and Reservoir Quality of the Upper Mississippian Aux Vases Sandstone, Illinois Basin
Pitman, J. K.; Henry, M.; Leetaru, H.; 1999; 32p; In English
Report No.(s): PB2000-101770; USGS/PP-1609; No Copyright; Avail: National Technical Information Service (NTIS)
The Aux Vases Sanstone (Upper Mississippian) is extensively cored in the Illinois Basin and thus offers the opportunity to study diagenetic processes that occurred under different temperatures and burial conditions. Major diagenetic events observed in the Aux Vases Sandstone interval include (1) precipitation of precompactional illite and grain-rimming chlorite, (2) quartz overgrowth, syntaxial calcite, and dolomicrospar cementation, (3) carbonate-cement and framework-grain dissolution, (4) illite and chlorite authigenesis, (5) ankerite precipitation, and (6) hydrocarbon emplacement.
NTIS
Reservoirs; Water Quality; Illinois

20000020961 Geological Survey, Water Resources Div., Reston, VA USA
Water Resources of the Prairie Island Indian Reservation, Minnesota, *1994 - 1997*
Cowdery, T. K.; 1999; 44p; In English
Report No.(s): PB2000-102345; USGS/WRI-99-4069; No Copyright; Avail: National Technical Information Service (NTIS)
This evaluation of the water resources on the Prairie Island Indian Reservation includes data collected from 8 surface-water sites and 22 wells during 1994-97 and historical data.
NTIS
Water Resources; Minnesota; Evaluation; Data Acquisition

20000020964 Michigan Univ., Cooperative Inst. for Limnology and Ecosystems Research, Ann Arbor, MI USA
Physical and Chemical Variables of Saginaw Bay, Lake Huron in 1994-1996, *1994-1996*
Johengen, T. H.; Nalepa, T. F.; Lang, G. A.; Fanslow, D. L.; Vanderploeg, H. A.; Jan. 2000; 44p; In English
Report No.(s): PB2000-102421; No Copyright; Avail: Issuing Activity
Physical and chemical data were collected in Saginaw Bay, Lake Huron over the period 1991-1996 as part of a monitoring program to assess the ecological impact of the zebra mussel, Dreissena polymorpha. This report presents monitoring results for the years 1994-1996 and builds upon the previous technical memorandum GLERL-91 (PB96-182357) that described results for the years 1991-1993. Detailed accounts of sampling times, locations, and methods, and analytical procedures are included in each of the reports.
NTIS
Water Sampling; Physical Properties; Chemical Properties; Sampling; Lake Huron

43
EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see 35 Instrumentation and Photography.

20000017999 Old Dominion Univ., Lab. for Coastal Remote Sensing and Environmental Analysis, Norfolk, VA USA
Reflected GPS Power for the Detection of Surface Roughness Patterns in Coastal Water ***Final Report, Period ending 31 Aug. 1999***
Oertel, George, F., Old Dominion Univ., USA; Allen, Thomas R., Old Dominion Univ., USA; January 2000; 17p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG1-2082
Report No.(s): ODURF-154952; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Coastal bays formed by the barrier islands of Delaware, Maryland and Virginia are parts of a coastal region known as a ”Coastal Compartment”. The coastal compartment between the Chesapeake and Delaware Bays is actually the mosaic of landscapes on the headland of the interfluve that separates these large drainage basins. The coastal compartments form a variety of different-shaped waterways landward of the coastline. Shape differences along the boundaries produce differences in exposure to wind and waves. Different shoreface topographies seaward of the coastline also influence surface roughness by changing wave-refraction patterns. Surface-water roughness (caused by waves) is controlled by a number of parameters, including fetch, shielding, exposure corridors, water-mass boundary conditions, wetland vegetation and water depth in coastal bays. In the coastal ocean, surface roughness patterns are controlled by shoreface shoaling and inlet refraction patterns in the coastal ocean. Knowledge of wave phenomena in the nearshore and backbarrier areas is needed to understand how wave climate influences important ecosystems in estuaries and bays.
Author
Chesapeake Bay (US); Coasts; Global Positioning System; Ocean Surface; Surface Water; Topography; Sea Roughness; Oceanography

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.

20000019621 Army Materiel Systems Analysis Activity, Rock Island, IL USA
Rechargeable Battery/Systems for Communication/Electronic Applications: An Analysis of Technology Trends, Applications and Projected Business Climate
Sep. 30, 1999; 121p; In English
Contract(s)/Grant(s): DAAL01-94-C-0048
Report No.(s): AD-A370975; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy

The North American Technology and Industrial Base Organization (NATIBO) study of the rechargeable battery and battery charger technology and the associated industrial base highlights the state-of-the-art and future trends of this technology and industrial base as well as the ability of industry to meet future military communication and electronic requirements. The objective of the study was to compare the current trends in the commercial rechargeable battery and battery charger markets to the requirements of the military. The study gives an analysis of battery chemistries (sealed lead acid, nickel cadmium, nickel-metal hydride, lithium- ion, lithium polymer) and technology trends, an overview of current and potential defense and commercial applications of the rechargeable batteries. It assessed which battery and battery charging technologies will be required/desired for military communication and electronic equipment and analyzed the North American technology and industrial base capability to produce the type and quantities of rechargeable batteries required by the DoD and DND. The report identifies a number of recommendations that could facilitate a successful full-scale transition to rechargeable batteries for fulfilling military communication power needs.
DTIC
Electronic Equipment; Battery Chargers; Storage Batteries; Technology Assessment

20000020910 National Renewable Energy Lab., Golden, CO USA

Recombination Lifetime of In(x)Ga(1-x)As Alloys Used in Thermophotovoltaic Converters

Carapella, J.; Webb, J.; Wanlass, M.; Feb. 16, 1999; 6p; In English; 4th; 4th Conference on Thermophotovoltaic Generation of Electricity, 11-14 Oct. 1998, Denver, CO, USA

Report No.(s): DE00-006579; NREL/CP-520-25420; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

The family of ternary compounds of composition In(x)Ga(1-x)As are of considerable interest for thermophotovoltaic energy converters. The recombination lifetimes of the various compositions are critical to the successful application of these materials as efficient converters. We describe experimental results on the composition. In(0.53)Ga(0.47) that is lattice-matched to InP. We also describe lifetime results on the compositions In(0.68)Ga(0.32)As, with bandgap of 0.60 eV to compositions In(0.78)Ga(0.22)As with a bandgap of 0.50 eV. Double heterostructure confinement devices have been made over a range of both n- and p-type doping. These results are preliminary, but the goal is to obtain the radiative and Auger recombination coefficients for the alloys in this composition range.

NTIS

Thermophotovoltaic Conversion; Indium Arsenides; Gallium Arsenides; Radiative Recombination

20000020912 National Renewable Energy Lab., Golden, CO USA

Costs of Storing and Transporting Hydrogen

Amos, Wade A.; Jan. 27, 1999; 896p; In English

Report No.(s): DE00-006574; NREL/TP-570-25106; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

An analysis was performed to estimate the costs associated with storing and transporting hydrogen. These costs can be added to a hydrogen production cost to determine the total delivered cost of hydrogen. Storage methods analyzed included compressed gas, liquid hydrogen, metal hydride, and underground storage. Major capital and operating costs were considered over a range of production rates and storage times.

NTIS

Hydrogen; Transportation; Compressed Gas; Costs; Liquid Hydrogen; Underground Storage

20000020913 National Renewable Energy Lab., Golden, CO USA

Analysis of Two Biomass Gasification/Fuel Cell Scenarios for Small-Scale Power Generation

Amos, W. A.; Jan. 12, 1999; 6p; In English

Report No.(s): DE00-003705; NREL/TP-570-25886; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

Two scenarios were examined for small-scale electricity production from biomass using a gasifier/fuel cell system. In one case, a stand-alone BCL/FERC gasifier is used to produce synthesis gas that is reformed and distributed through a pipeline network to individual phosphric acid fuel cells. In the second design, the gasifier is integrated with a molten carbonate fuel cell stack and a steam bottoming cycle. In both cases, the gasifiers are fed the same amount of material, with the integrated system producing 4 MW of electricity, and the stand-alone design generating 2 MW of electricity.

NTIS

Biomass; Gasification; Molten Carbonate Fuel Cells; Electricity

20000020919 Houston Advanced Research Center, The Woodlands, TX USA

Center for Fuel Cell Research and Applications development phase *Final Report*

Dec. 31, 1998; 100p; In English

Report No.(s): DE99-002415; DOE/GO/10361-T2; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

The deployment and operation of clean power generation is becoming critical as the energy and transportation sectors seek ways to comply with clean air standards and the national deregulation of the utility industry. However, for strategic business decisions, considerable analysis is required over the next few years to evaluate the appropriate application and value added from this emerging technology. to this end the Houston Advanced Research Center (HARC) is proposing a three-year industry-driven project that centers on the creation of 'The Center for Fuel Cell Research and Applications'. A collaborative laboratory housed at and managed by HARC, the Center will enable a core group of six diverse participating companies--industry participants--to investigate the economic and operational feasibility of proton-exchange-membrane (PEM) fuel cells in a variety of applications (the core project). This document describes the unique benefits of a collaborative approach to PEM applied research, among them a shared laboratory concept leading to cost savings and shared risks as well as access to outstanding research talent and lab facilities. It also describes the benefits provided by implementing the project at HARC, with particular emphasis on HARC's history of managing successful long-term research projects as well as its experience in dealing with industry consortia projects. The Center is also unique in that it will not duplicate the traditional university role of basic research or that of the fuel cell industry

in developing commercial products. Instead, the Center will focus on applications, testing, and demonstration of fuel cell technology.
NTIS
Fuel Cells; Air Quality; Transportation; Research; Hydrogen Fuels; Technology Utilization

20000020948 Sandia National Labs., Albuquerque, NM USA
Performance of the Solar Two Central Receiver Power Plant
Prairie, M. R.; Pacheco, J. E.; Gilbert, R. L.; Reilly, H. E.; Speidel, P. J.; Dec. 31, 1998; 12p; In English; 9th; Solar Thermal Concentrating TechnologiesP, 22-26 Jun. 1998, Odeillo, France; Prepared in cooperation with Shada Environmental Specialists, Inc., Huntington Beach, CA.
Report No.(s): DE98-003502; SAND-97-3196C; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

Solar Two is a utility-led project to promote the commercialization of solar power to towers by retrofitting the Solar One pilot plant from a water/steam based system to a molten salt system. Solar Two is capable of producing a 10MW net electricity with enough thermal storage capacity to operate the turbine for three hours after sunset. Solar Two has collected as much as 230 MWh thermal and generated as much as 72 MWh(e) gross electricity in one day. Important lessons have been learned in the areas of heat trace, valve selection, materials of construction, and steam generator design. Testing has begun in a number of areas relating to receiver performance, storage tank performance, salt chemistry, overnight thermal conditioning, electricity dispatching, performance monitoring and evaluation, availability tracking, and receiver controls.
NTIS
Molten Salts; Electric Power Plants; Retrofitting; Electricity; Fabrication

20000020957 National Renewable Energy Lab., Golden, CO USA
High-Performance, 0.6-eV, GA(0.32)In(0.68)As/In(0.32)P(0.68) Thermophotovoltaic Converters and Monolithically Interconnected Modules
Duda, A.; Murray, C. S.; Dec. 15, 1998; 6p; In English; 4th; 4th Conference on Thermophotovoltaic Generation of Electricity, 11-14 Oct. 1998, Denver, CO, USA
Report No.(s): DE00-007141; NREL/CP-520-25539; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

Recent progress in the development of high-performance, 0.6-eV Ga(0.32)In(0.68)As/InAs(0.32)P(0.68) thermophotovoltaic (TPV) converters and monolithically interconnected modules (MIMs) is described. The converter structure design is based on using a lattice-matched InAs(0.32)P(0.68)/Ga(0.32)In (0.68)As/InAs(0.32)P(0.68) double-heterostructure (DH) device, which is grown lattice-mismatched on an InP substrate, with an intervening compositionally step-graded region of InAsyP(1-y). The Ga(0.32)In(0.680As alloy has a room-temperature band gap of; 0.6 eV and contains a p/n junction. The InAs(0.32)P(0.68) layers have a room-temperature band gap of ;0.96 eV and serve as passivation/confinement layers for the Ga(0.32)In(0.68)As p/n junction. InAsyP(1-y) step grades have yielded DH converters with superior electronic quality and performance characteristics. Details of the microstructure of the converters are presented. Converters prepared for this work were grown by atmospheric-pressure metalorganic vapor-phase epitaxy (APMOVPE).
NTIS
Thermophotovoltaic Conversion; Gallium Arsenides; Indium Arsenides; Indium Phosphides; Vapor Phase Epitaxy

20000021007 Bundesministerium fuer Bildung, Forschung und Technoglogie, Bonn, Germany
Control of industrial scale wind power systems in low mountain sites *Final Report*
Caselitz, P.; Krueger, T.; Petschenka, J.; Reichardt, M.; Dec. 31, 1998; 78p; In German; In English
Report No.(s): DE98-776472; ETDE-DE-702; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

The authors worked on a new measurement and control system for testing new control methods that will reduce mechanical loads on wind power plants especially in inland low mountain sites. The system was tested on a big wind power plant of the 1.5 MW range of Tacke Windtechnik GmbH. An extensive measuring campaign was projected on a prototype TW 1.5 at Vogelsberg wind park. Unfortunately, Tacke Windechnik GmbH went bankrupt, so the plant could not be finished on time. The report therefore presents only the measurement and control system and the control methods.
NTIS
Windpower Utilization; Wind Turbines; Control Systems Design

20000021040 New Mexico Univ., Dept. of Chemical and Nuclear Engineering, Albuquerque, NM USA

Experimental Investigations, Modeling, and Analyses of High-Temperature Devices for Space Applications, Part 2 ***Final Report, Jun. 1996 - Dec. 1998***

Tournier, Jean-Michel; El-Genk, Mohamed S.; Huang, Lianmin; Jan. 1999; 268p; In English

Contract(s)/Grant(s): F29620-97-K-0123; AF Proj. 682J

Report No.(s): AD-A366804; AFRL-VS-PS-TR-1998-1108; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The Institute of Space and Nuclear Power Studies at the University of New Mexico has developed a computer simulation of cylindrical geometry alkali metal thermal-to-electric converter cells using a standard FORTRAN 77 computer code. The objective and use of this code was to compare the experimental measurements with computer simulations, upgrade the model as appropriate, and conduct investigations of various methods to improve the design and performance of the devices for improved efficiency, durability, and longer operational life-time. The Institute of Space and Nuclear Power Studies participated in vacuum testing of PX series alkali metal thermal-to-electric converter cells and developed the alkali metal thermal-to-electric converter Performance Evaluation and Analysis Model. This computer model consisted of a sodium pressure loss model, a cell electrochemical and electric model, and a radiation/conduction heat transfer model. The code closely predicted the operation and performance of a wide variety of PX series cells which led to suggestions for improvements to both lifetime and performance. The code provides valuable insight into the operation of the cell, predicts parameters of components within the cell, and is a useful tool for predicting both the transient and steady state performance of systems of cells.

DTIC

Computerized Simulation; Alkali Metals; Technology Utilization

45
ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20000014431 California Univ., Dept. of Land, Air and Water Resources, Davis, CA USA

Aircraft Measurements in Support of the 1997 Southern California Ozone Study ***Final Report***

Carroll, J. J.; Dixon, A. J.; Mar. 1999; 50p; In English

Contract(s)/Grant(s): CARB-95-332

Report No.(s): PB2000-102383; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the summer of 1997, an instrumented aircraft was deployed by the University of California at Davis (UCD) to measure meteorological and air quality variables along the foothills north and east of Central Los Angeles. This was part of a larger effort, the 1997 Southern California Ozone Study - North American Research Strategy for Tropospheric Ozone (SCOS97). Data and air samples were collected during six intensive operational periods (IOP) covering fifteen intensive operational days. Instrument calibrations showed all measuring systems operated well within design limits and generally all data are of high quality. One exception is with the oxides of nitrogen analyzer which did not correct for non-standard temperature and pressures. However, in most instances when significant levels of nitrogen oxides were measured these environmental variables were close to their standard value.

NTIS

Ozone; Meteorological Parameters; Air Quality; Air Pollution; Pollution Monitoring

20000014433 National Inst. for Occupational Safety and Health, Div. of Surveillance, Hazard Evaluations and Field Studies, Cincinnati, OH USA

Health Hazard Evaluation Report HETA 99-0047-2746, Edgcomb Metals, Cincinnati, Ohio

Harney, J. M., National Inst. for Occupational Safety and Health, USA; Tubbs, R. L., National Inst. for Occupational Safety and Health, USA; Jul. 1999; 24p; In English

Report No.(s): PB2000-101766; HETA-99-0047-2746; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from an employer representative of Edgcomb Metals in Cincinnati, Ohio. The request listed noise exposure and confined spaces as issues of concern. Because of consolidation of facilities, a substantial portion of the workforce had been hired just in the last year, and new machinery had been added to the facility since the last noise monitoring had been done. Time-weighted average (TWA) noise exposures during two days of personal noise monitoring showed that exposures were not above the Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL). They were, however, over 85 on the A-weighted decibel (dB(A)) scale when calculated using the NIOSH recommended 3 dB exchange rate. Most workers had at least mild hearing loss

(hearing threshold level (HTL) of 25 dB sound pressure level (SPL) or more at tested frequencies), as determined from review of the company's audiometric test records.
NTIS
Health; Hazards

20000014436 Helsinki Univ. of Technology, Lab. of Environmental Engineering, Espoo, Finland
Organic Matter and Polyhydroxyalkanoates in Biological Phosphate Removal from Municipal Wastewater ***Orgaaninen Aine ja Polyhydroksialkanoaatit Biologisessa Fosforin Poistossa Yhdyskuntien Jaetevesistae***
Aurola, Anne-Mari, Helsinki Univ. of Technology, Finland; 1999; ISSN 1456-8314; 60p; In English; Sponsored in part by Maj and Tor Nessling Foundation, National Technology Agency and Land and Water Technology Foundation
Report No.(s): PB2000-100826; TKK-VHT-25; ISBN 951-22-4636-8; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy
This study presents the importance of polyhydroxyalkanoates (PHA) in the biological phosphate removal (BPR) in a UCT-type process treating municipal wastewater was weak, containing only (presented as mean values) 275 mg COD(sub Cr)/1, 5.6 mg P/1 and 41 mg N/1. The average ratio between influent total COD and total phosphorus was approximately 50.
Author (NTIS)
Organic Materials; Phosphates; Removal; Contaminants; Decontamination; Water Treatment

20000017966 Midwest Research Inst., Kansas City, MO USA
Lime Manufacturing Emissions Test Report (Fourier Transform Infrared Spectroscopy). Final Report. Chemical Lime Company (Formerly APG Lime Company) Ripplemead, Virginia
Sep. 30, 1999; 258p; In English
Report No.(s): PB2000-102475; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche
The purpose of this project was to measure organic and inorganic hazardous air pollutants (HAPs) using a test method based on Fourier Transform Infrared Spectroscopy. This report describes the test procedures and presents results of the testing at APG Lime plant in Ripplemead, Virginia.
NTIS
Air Pollution; Contamination; Contaminants; Hazardous Materials; Organic Materials; Inorganic Materials

20000017967 Massachusetts Inst. of Tech., Dept. of Earth, Atmospheric and Planetary Sciences, Cambridge, MA USA
Physical Processes Governing Atmospheric Trace Constituents Measured from Aircraft in Pem-Tropics ***Final Report, 1 Oct. 1995 - 30 Sep. 1999***
Newell, Reginald E., Massachusetts Inst. of Tech., USA; [1999]; 11p; In English
Contract(s)/Grant(s): NAG1-1758; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The MIT group participated in seven publications in the 1999 issues of JGR with sections devoted in PEM-Tropics A, and had two papers which may be considered offshoots of these studies combined with commercial aircraft trace constituents data, one in Nature and one in EOS. In the meteorological overview we contributed a set of 1000 hPa divergent wind maps which we calculated from ECMWF data, meridional wind cross-sections, velocity potential and divergent wind maps, maps of stream function and rotational wind components, and vertical velocity profiles computed from mass balance, these all constituting part of the overall climatology. We also contributed material for the "stalactite" case observed from the DC-8 on September 3, 1996. This included a map of potential vorticity on 350 K, a cross-section of lidaro O3 a cross-section of potential vorticity along 140 deg W, and a map of specific humidity showing extreme dryness accompanying the high potential vorticity values and the high ozone values, all suggesting subsidence from the local stratosphere. In the paper on chemical characteristics we contributed 12 hour values of the 1000 hPa divergent wind component for the full period of PEM Tropics A; these were used by David Westberg to establish the air mass boundaries and in turn used by Gerry Gregory to set up a table of quantitative values of trace constituents and their ratios both sides of the boundaries.
Derived from text
Atmospheric Circulation; Air Masses; Humidity; Mass Distribution; Velocity Distribution; Wind (Meteorology)

20000019578 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Retrieval of Ozone Profiles from Limb Scatter Measurements: Results from the Shuttle Ozone Limb Sounding Experiment
McPeters, Richard D., NASA Goddard Space Flight Center, USA; Janz, Scott J., NASA Goddard Space Flight Center, USA; Hilsenrath, Ernest, NASA Goddard Space Flight Center, USA; Brown, Tammy L., NASA Goddard Space Flight Center, USA; Flittner, David E., Arizona Univ., USA; Heath, Donald F., RSI, USA; [1999]; 11p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two instruments were flown on shuttle flight STS-87 to test a new technique for inferring the ozone vertical profile using measurements of scattered sunlight from the Earth's limb. The instruments were an ultraviolet imaging spectrometer designed to measure ozone between 30 and 50 km, and a multi-filter imaging photometer that uses 600 nm radiances to measure ozone between 15 km and 35 km. Two orbits of limb data were obtained on December 2, 1997. For the scans analyzed the ozone profile was measured from 15 km to 50 km with approximately 3 km vertical resolution. Comparisons with a profile from an ozonesonde launched from Ascension Island showed agreement mostly within +/- 5%. The tropopause at 15 km was clearly detected.
Author
Ozone; Ozonometry; Chlorofluorocarbons; Atmospheric Composition

20000019583 Dynamac Corp., Cocoa Beach, FL USA
Environment Conditions and Threatened and Endangered Species Populations near the Titain, Atlas, and Delta Launch Complexes, Cape Canaveral Air Station
Oddy, Donna M., Dynamac Corp., USA; Stolen, Eric D., Dynamac Corp., USA; Schmalzer, Paul A., Dynamac Corp., USA; Hensley, Melissa A., Dynamac Corp., USA; Hall, Patrice, Dynamac Corp., USA; Larson, Vickie L., Dynamac Corp., USA; Turek, Shannon R., Dynamac Corp., USA; June 1999; 254p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS10-12180
Report No.(s): NASA/TM-2000-208553; NAS 1.15:208553; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche
Launches of Delta, Atlas, and Titan rockets from Cape Canaveral Air Station (CCAS) have potential environmental effects. These could occur from direct impacts of launches or indirectly from habitat alterations. This report summarizes a three-year study (1995-1998) characterizing the environment, with particular attention to threatened and endangered species, near Delta, Atlas, and Titan launch facilities. Cape Canaveral has been modified by Air Force development and by 50 years of fire suppression. The dominant vegetation type around the Delta and Atlas launch complexes is coastal oak hammock forest. Oak scrub is the predominant upland vegetation type near the Titan launch complexes. Compositionally, these are coastal scrub communities that has been unburned for greater than 40 years and have developed into closed canopy, low-stature forests. Herbaceous vegetation around active and inactive facilities, coastal strand and dune vegetation near the Atlantic Ocean, and exotic vegetation in disturbed areas are common. Marsh and estuarine vegetation is most common west of the Titan complexes. Launch effects to vegetation include scorch, acid, and particulate deposition. Discernable, cumulative effects are limited to small areas near the launch complexes. Water quality samples were collected at the Titan, Atlas, and Delta launch complexes in September 1995 (wet season) and January 1996 (dry season). Samples were analyzed for heavy metals, chloride, total organic carbon, calcium, iron, magnesium, sodium, total alkalinity, pH, and conductivity. Differences between fresh, brackish, and saline surface waters were evident. The natural buffering capacity of the environment surrounding the CCAS launch complexes is adequate for neutralizing acid deposition in rainfall and launch deposition. Populations of the Florida Scrub-Jay (Aphelocoma coerulescens), a Federally- listed, threatened species, reside near the launch complexes. Thirty-seven to forty-one scrub-jay territories were located at Titan, Atlas, and Delta launch complexes between 1995 and 1997. No direct impacts to scrub-jays were observed as a result of normal launches. The explosion of the Delta rocket in January 1997 caused direct impacts to the habitat of several scrub-jays families, from fire and debris; however, no scrub-jay mortality was observed. Mortality exceeded reproductive output at all areas over the course of the study. Populations of the southeastern beach mouse (Peromyscus polionotus niveiventris) populations, a Federally listed, threatened species, reside near all the launch complexes. Hurricane Erin and several other tropical storms impacted several areas at the inception of the study in 1995 causing coastal habitat alterations as a result of salt-water intrusion. Both the habitat and the beach mice populations recovered during the course of the study. No direct impacts to southeastern beach mice were observed as a result of normal launch operations. Direct impacts were observed to the habitat as a result of the explosion of the Delta rocket in January 1997. This alteration of the habitant resulted in a shift in use with the mice moving on to the newly burned part of the site. Waterbirds use wetlands and aquatic systems near the launch complexes. Species include the Federally-listed, endangered Wood Stork (Mycteria americana) and several state-listed species of special concern including the Snowy Egret (Egretta thula thula), Reddish Egret (Egretta rufescens rufescens), White Ibis (Eudocimus albus), Roseate Spoonbill (Ajaia ajaja), Tricolored Heron (Egretta tricolor ruficolis), and Little Blue Heron (Egretta caerulea). No impacts to these populations resulting from any launch operations were observed. Gopher tortoises (Gopherus polyphemus) also occur around the launch complexes. Most of those observed appeared to be in good condition; however, upper respiratory tract disease is known to occur in the population. Cape Canaveral Air Station, including areas near active launch complexes, remains important habitat for a variety of native plants and animals including threatened and endangered species. Direct negative effects of current launch systems appear limited. Additional monitoring of these populations and habitats is required to determine if subtle, long-term changes are occurring, to

determine if new launch systems and facilities cause other effects, and to determine the effects of habitat restoration and management.
Author
Acid Rain; Calcium; Carbon; Deposition; Endangered Species; Environment Effects; Explosions; Habitats; Launching; Launching Bases; Spacecraft Launching; Water Quality

20000019596 Huntington Consulting, Eagle River, AR USA
Report of the Meeting of the Arctic Monitoring and Assessment Program (AMAP) Working Group (12th) ***Final Report***
Huntington, H. P., Huntington Consulting, USA; Jan. 1999; 298p; In English
Report No.(s): PB2000-102445; No Copyright; Avail: CASI; A03, Microfiche; A13, Hardcopy
This report describes the Arctic Monitoring and Assessment Program (AMAP) established under the Arctic Environmental Protection Strategy; outlines the significant discussions held during the twelfth meeting of the AMAP Working Group (AMAP XII) held in Helsinki, Finland, December 7-9, 1998; and concludes with observations and suggestions to the Marine Mammal Commission concerning the role of the USA and of the Commission with regard to AMAP and the Arctic Council.
NTIS
Arctic Regions; Environment Protection; Marine Mammals; Research

20000019647 Midwest Research Inst., Kansas City, MO USA
Lime Manufacturing Emissions Test Report (Fourier Transform Infrared Spectroscopy). Chemical Lime Company (Fomerly Eastern Ridge Lime Company) Ripplemead, Virginia
Sep. 30, 1999; 218p; In English
Report No.(s): PB2000-102474; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
The purpose of this project was to measure organic and inorganic hazardous air pollutants (HAPs) using a test method based on Fourier Transform Infrared Spectroscopy. This report describes the test procedures and presents results of the testing at Eastern Ridge Lime plant in Ripplemead, Virginia.
NTIS
Hazardous Materials; Contaminants; Organic Materials; Inorganic Materials; Air Pollution; Calcium Oxides; Manufacturing

20000020894 Geological Survey, Water Resources Div., Northborough, MA USA
Distribution and Transport of Total Mercury and Methylmercury in Mercury-Contaminated Sediments in Reservoirs and Wetlands of the Sudbury River, East-Central Massachusetts
Colman, J. A.; Waldron, M. C.; Breault, R. F.; Lent, R. M.; 1999; 26p; In English
Report No.(s): PB2000-101835; USGS/WRI-99-4060; No Copyright; Avail: National Technical Information Service (NTIS)
Total mercury and methylmercury were measured in 4 reservoir cores and 12 wetland cores from Sudbury River. The distribution of total mercury and methylmercury in these cores was evaluated to determine the potential for total mercury and methylmercury transport from reservoir and wetlands sediments to the water column. Corrected methylmercury concentrations correlated with total mercury concentrations in bulk sediment from below the top layers of reservoir and wetland cores; methylmercury concentrations at the top layers of cores were relatively high, however, and were not correlated with total mercury concentrations. Concentrations of methylmercury in pore water were positively correlated with methylmercury concentrations in the bulk sediment. High concentrations of total mercury and methylmercury in sediment (73 and 0.047 micrograms per gram dry-weight basis, respectively) contributed less to the water column in the reservoir than in the wetlands probably because of burial by low concentration sediment and differences in the processes available to transport mercury from the sediments to the water in the reservoirs, as compared to the wetlands.
NTIS
Mercury (Metal); Sediments; Mercury Compounds; Methyl Compounds

20000020900 Battelle Columbus Labs., Washington, DC USA
International Emissions Trading and Global Climate Change: Impacts on the Costs of Greenhouse Gas Mitgation
Edmonds, J.; Scott, M. J.; Roop, J. M.; MacCracken, C. N.; Dec. 1999; 54p; In English; Original contains color illustrations
Report No.(s): PB2000-102202; No Copyright; Avail: National Technical Information Service (NTIS)
Several factors influence the costs of greenhouse gas mitigation. This report illustrates the importance of one such factor, international emissions trading, in reducing the costs of carbon control. The authors find that an international greenhouse gas emissions trading regime will significantly lower global mitigation costs. This report is the first in a series designed to explore how economic models address the climate change issue. The first phase of this effort will make a direct and significant contribution

to economic modeling in the following four areas: (1) review of existing models and identification of their key assumptions; (2) investigation of the models theoretical frameworks; (3) encouraging best practices in modeling specific aspects of the climate change issue; and (4) integrating innovative modeling practices into a state-of-the-art assessment of the costs of climate change and the policies used to address it.
NTIS
Greenhouse Effect; International Cooperation; Exhaust Emission; Exhaust Gases; Climate Change

20000020901 Van Ness Feldman, Washington, DC USA
Complex Elements of Global Fairness
Claussen, E.; McNeilly, L.; Oct. 1, 1998; 54p; In English; Original contains color illustrations
Report No.(s): PB2000-102203; No Copyright; Avail: National Technical Information Service (NTIS)

This report, which analyzes proposals to credit early, voluntary actions to mitigate greenhouse gas emissions, is the first in a series to be published by the Pew Center on Global Climate Change. The Pew Center was established in 1998 by the Pew Charitable Trusts to bring a new cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. Some U.S. companies have indicated support for early action programs in keeping with their desire to take immediate action to reduce greenhouse gases and their need for assurance that such actions will be rewarded and not punished.This report addresses the issues that policy makers will face in designing a domestic early action program, analyzes current proposals, and suggests a set of principles to guide an effective program. It suggests that, regardless of any eventual international framework, the U.S. can take steps to credit reductions in gases now, and therefore encourage and reward companies that act to minimize their emissions. The longer we wait to address climate change, the more it is likely to cost both environmentally and economically. The Pew Center concludes: THE COST OF DELAY IS SIGNIFICANT; U.S. LEADERSHIP IS IMPERATIVE; AND LEADERSHIP MUST START WITH CONGRESS.
NTIS
Exhaust Emission; Exhaust Gases; Greenhouse Effect; Climate Change; Policies

20000020903 Pew Center on Global Climate Change, Arlington, VA USA
Complex Elements of Global Fairness
Claussen, E.; McNeilly, L.; Oct. 29, 1998; 42p; In English; Original contains color illustrations
Report No.(s): PB2000-102205; No Copyright; Avail: National Technical Information Service (NTIS)

What constitutes a fair response to climate change is the main question underlying many of the unresolved issues in the climate change debate. It is behind the questions of the level of commitment by industrialized countries, the type of participation to be undertaken by developing countries, the structure of the various trading mechanisms, and the nature and magnitude of financial obligations. What has been missing from the debate, however, are consensus principles that define equity in the context of this issue. This report, which offers insight on global equity, is the second in a series by the Pew Center on Global Climate Change. Using the language already in the Framework Convention and the Kyoto Protocol and the way equity has been invoked in other international treaties as a backdrop, the report lays out a new paradigm. The authors suggest that three criteria - responsibility for the emissions that can cause climate change, standard of living (or the ability to pay for climate change mitigation), and opportunity to reduce emissions should be considered in differentiating country obligations. Based on these criteria, the report suggests that it is appropriate to divide countries into three groups rather than two: those that must act now; those that should act now, but differently; and those that could act now if feasible. It is hoped that these ideas will stimulate debate and draw all parties toward an objective and transparent approach to this critical cause.
NTIS
Climate Change; Greenhouse Effect; Developing Nations; International Cooperation

20000020905 Oregon State Univ., Corvallis, OR USA
Review of Impacts to US Agricultural Resources
Adams, R. M.; Hurd, B. H.; Reilly, J.; Feb. 1999; 40p; In English; Original contains color illustrations
Report No.(s): PB2000-102207; No Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: Dimensions and Trends of U.S. Agriculture; Biophysical Effects of Climate Change on Crops and Livestock; The role of Human Response and adaptation to Climate Change; Impacts of Climate Change on Agricultural Production, Prices, and Welfare; Environmental Effects of Agricultural Production: Mitigation and Societal Responses to the Problem of Greenhouse Gas Emissions.
NTIS
Agriculture; USA

20000020906 National Center for Atmospheric Research, Boulder, CO USA
Science of Climate Change: Global and US Perspectives
Wigley, T. M.; 1999; 54p; In English; Original contains color illustrations
Report No.(s): PB2000-102208; No Copyright; Avail: National Technical Information Service (NTIS)

This report on the science of climate change seeks to explain how climate is influenced by anthro-pogenic factors. Understanding the effect of greenhouse gas concentrations on the atmosphere is key to understanding the potential magnitude of the greenhouse effect, evaluating possible environmental impacts, and considering policy responses.The report's publication comes in an interim period between assessments of the science by the Intergovernmental Panel on Climate Change (which published its second assessment in 1996 and will publish its third assessment in 2001). The author uses preliminary estimates of greenhouse gas and sulfur dioxide emissions from the current IPCC review process as well as his own work to supplement previously published research.
NTIS
Climate Change; Greenhouse Effect; Global Warming; Environment Management

20000020916 Geo-Centers, Inc., Newton, MA USA
Development of Analytical and Environmental Diagnostic Techniques ***Final Report, Sep. 1995 - Sep. 1999***
Steele, J. K.; Oct. 29, 1999; 17p; In English
Contract(s)/Grant(s): N00014-95-C-2054
Report No.(s): AD-A370124; GC-FR-2834; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This Final Report is a complication of the publications and presentations generated and/or the accomplishments made per task/project, for the tasks performed in support of the development of analytical and environmental diagnostic techniques during the period of September 1995 - September 1999. The task description of each task/project -- as designated in the Statement of Work -- is included for convenience.
DTIC
Chemical Analysis; Diagnosis; Environment Management

20000020925 ARCADIS Geraghty and Miller, Inc., Research Triangle Park, NC USA
Quantification of Methane Emissions and Discussion of Nitrous Oxide and Ammonia Emissions from Septic Tanks, Latrines, and Stagnant Open Sewers in the World
Doorn, M. R. J.; Liles, D. S.; Oct. 1999; 60p; In English
Report No.(s): PB2000-101018; No Copyright; Avail: National Technical Information Service (NTIS)

This study is a first attempt to estimate global and country-specific methane (CH4) emissions from open sewers and on-site wastewater treatment systems, including latrines and septic sewage tanks. This study uses an emission factor that expresses CH4 emissions in terms of removed Chemical Oxygen Demand (COD(removed)). An appendix to this report includes a discussion of nitrogen cycle effects in these systems to qualify ammonia (NH3) and nitrous oxide (N2O) emissions from these systems. It was concluded that these systems are not likely to contribute and significant quantity of NH3 and N2O to the atmosphere.
NTIS
Methane; Nitrous Oxides; Sewers; Air Pollution; Quantitative Analysis

20000020935 Department of Energy, Office of Integrated Analysis and Forecasting, Washington, DC USA
Voluntary Reporting of Greenhouse Gases, ***1998***
Dec. 1999; 202p; In English; Original contains color illustrations
Report No.(s): PB2000-101539; DOE/EIA-0608(98); No Copyright; Avail: National Technical Information Service (NTIS)

The Voluntary Reporting of Greenhouse Gases Program, required by Section 1605(b) of the Energy Policy Act of 1992, records the results of voluntary measures taken to reduce, avoid, or sequester greenhouse gas emissions. One hundred eighty-seven U.S. companies and other organizations reported to the Energy Information Administration that, during 1998, they had undertaken 1,507 projects that achieved greenhouse gas emission reductions and carbon sequestration equivalent to 212 million metric tons of carbon dioxide, or about 3.2 percent of total U.S. emissions for the year. The emission reductions reported for these projects usually were measured by comparing an estimate of actual emissions with an estimate of what emissions would have been had the project not been implemented. Since 1994, the number of projects reported each year has increased by 134 percent, and the quantity of emission reductions reported each year has roughly tripled. Sixty-five of the organizations reporting for 1998 provided

estimates of emissions and/or emission reductions for the entire organization. Sixty-seven reporters recorded commitments to take action to reduce emissions in future years, mostly by the year 2000.
NTIS
Greenhouse Effect; Exhaust Emission; Carbon Dioxide

20000020951 Illinois State Environmental Protection Agency, Div. of Labs., Springfield, IL USA
Combined Lists of Environmental Laboratories ***Annual Report***
Oct. 29, 1999; 54p; In English
Report No.(s): PB2000-101383; IEPA/LABS-99/019; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This combined list of laboratories includes laboratories certified by the Illinois Environmental Protection Agency or the Illinois Department of Public Health or the Illinois Department of Nuclear Safety as capable of carrying out analyses in drinking water. This combined list also includes laboratories currently in the Illinois EPA's Contract Laboratory Program (CLP).
NTIS
Environmental Laboratories; Environment Protection

20000020965 Sierra Research, Inc., Sacramento, CA USA
Characterization of Emissions from Nickel Plating, Volume 1, Technical Report ***Final Report***
Adkins, J.; Jun. 21, 1999; 48p; In English
Report No.(s): PB2000-102472; No Copyright; Avail: Issuing Activity
The purpose of the study is to further address the quantity of emitted nickel and nickel compounds from plating operations; the characteristics inherent to nickel plating operations that result in emissions; and, most importantly, the potential nickel and nickel compound emissions from these operations. Emissions estimates available from electroplating sources have been reviewed, and the quality of the estimates and source test results has been assessed as part of this work. For this report, an extensive search was conducted of the technical literature and several data sources pertaining to airborne nickel emissions from plating operations to characterize the emissions from nickel plating operations. the magnitude of emission factors as well as the impact of process variables on emissions are reported, along with an assessment of the cost and efficacy of potential control measures.
NTIS
Electroplating; Nickel Coatings

20000020966 Sierra Research, Inc., Sacramento, CA USA
Characterization of Emissions from Nickel Plating, Volume 2, Appendices ***Final Report***
Adkins, J.; Jun. 21, 1999; 438p; In English
Report No.(s): PB2000-102473; No Copyright; Avail: Issuing Activity
A literature search and surveys were conducted to identify and collect all available nickel emissions testing reports or information for airborne nickel releases from nickel plating operations. A comprehensive literature search of several databases (listed in Appendix C) was conducted to identify and collect available emissions-related information for the nickel plating industry. A detailed bibliography provides references for the documents cited, as well as other documents reviewed. The literature search was supplemented with survey calls to nickel plating associations, nickel plating operators, and regulatory agencies (see Appendices A and B). In addition, calls were made to approximately 50 nickel plating firms or service agencies and governmental agencies for the most current information (see Appendix D). The literature search indicated that the majority of the emissions data available for nickel plating belongs to the nickel platers and the U.S. Environmental Protection Agency (EPA).
NTIS
Nickel Coatings; Electroplating

20000020967 Environmental Protection Agency, Office of Water, Washington, DC USA
Method OIA-1677: Available Cyanide by Flow Injection, Ligand Exchange, and Amperometry ***Final Report***
Straka, M.; Milosavljevic, E.; Solujic, L.; Jan. 2000; 34p; In English; Prepared in cooperation with OI Analytical, College Station, TX and Mackay School of Mines, Reno, NV
Report No.(s): PB99-132011; EPA/821/R-99/013; No Copyright; Avail: Issuing Activity
This method is for determination of available cyanide in water and wastewater by flow injection, ligand exchange, and amperometric detection. Cyanide ion (CN(sup -)), hydrogen cyanide (HCN(sub aq)), and the cyano-complexes of zinc, copper, cadmium, mercury, nickel, and silver may be determined by this method.
NTIS
Cyanides; Water Pollution; Chemical Analysis; Cyano Compounds

20000021008 Norwegian Inst. for Air Research, Kjeller, Norway

Elevated CO2 and development of frost hardness in Norway spruce (picea abies (L.) Karst)

Dalen, L. S.; Dec. 31, 1998; 68p; In English

Report No.(s): DE98-777249; NEI-NO-923; ISBN 82-575-0339-8; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

This thesis discusses controlled laboratory experiments carried out to study the effects of CO2 pollution on Norwegian spruce. It was found that elevated CO2 increased height growth and biomass production. It slightly increased frost hardness, but only at high nitrogen values. There was no evidence of adverse effects of elevated CO2 on the phenology of bud set and the development of frost hardiness. Although not statistically significant, there seemed to be a consistently higher concentration of soluble carbohydrates in one-season-old Norway spruce seedlings treated with elevated CO2. This was not found in three-year-old seedlings grown in open top chambers, possibly indicating a down-regulation of photosynthesis or a transition from free to predetermined growth, and change in allocation of photosynthesis with age. Treatment with high or low concentrations of CO2 and nitrogen fertilizer did not affect apoplastic chitinolytic activity during cold acclimation, nor were there any effects on antifreeze activity in these apoplastic extracts from cold acclimated needles.

NTIS

Carbon Dioxide; Pollution; Phenology; Frost

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.

20000014453 Geological Survey, Denver, CO USA

Structural Relationships of Pre-Tertiary Rocks in the Nevada Test Site Region, Southern Nevada

Cole, J. C.; Cashman, P. H.; 1999; 48p; In English

Report No.(s): PB2000-101104; USGS-PP-1607; LC-98-36129; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the evidence for a revised interpretation of major structural features in the pre-Tertiary rocks of the region including and surrounding the Nevada Test Site. The thick Miogeoclinal section of Late Proterozoic through Lower Permian sedimentary strata records major foreland-vergent thrust faulting, younger hinterland-vergent folding and thrusting, and local extension on low-angle normal faults. In addition, structural discontinuities in the north-eastern part of the Nevada Test Site strongly suggest a broad, north-trending zone of sinistral strike-slip faulting that may have had a cumulative offset of many kilometers.

NTIS

Rocks; Structures

20000017917 Alabama Univ., Huntsville, AL USA

Spacelab Scientific Impact: Atmospheric Science Investigations

Germany, Glynn A., Alabama Univ., USA; Spacelab Science Results Study; Aug. 18, 1999; Volume 1, pp. 53-88; In English; See also 20000017914; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The principal scientific contributions to atmospheric science from the Spacelab missions are... - a greater understanding of the chemistry and transport of the atmosphere, from the lower troposphere to the upper thermosphere, but with greatest emphasis on stratospheric trace gases and especially stratospheric ozone. The contribution from these investigations can be grouped into four catagories: observations made for the first time or of a unique event, observations made over an extended period of time or an extended spatial extent, observations detailed enough to provide heretofore unavailable constraints for model development and investigation, and correlative observations with other investigations. - increased knowledge of the impact of human activities on the lower atmosphere. Examples include transport of pollutants (both industrial and from biomass burning) across continents and oceans. This category can also include the studies of the optical glow environment of the space shuttle, since this must be understood and corrected for in any shuttle-based remote sensing investigation. - unprecedented opportunities for correlative studies and validations between multiple observing platforms, which are vital for quantitative atmospheric studies.

Author

Atmospheric Chemistry; Atmospheric Composition; Atmospheric Physics; Biomass Burning

20000017945 Colorado Univ., Dept. of Aerospace Engineering, Boulder, CO USA

Polar Geophysics Products Derived from AVHRR: The "AVHRR Polar Pathfinder ***Final Report***

Maslanik, James, Colorado Univ., USA; Fowler, Charles, Colorado Univ., USA; Scambos, Theodore, Colorado Univ., USA; December 1999; 35p; In English

Contract(s)/Grant(s): NAG5-4907; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This NOAA/NASA Pathfinder effort was established to locate, acquire, and process Advanced Very High Resolution Radiometer (AVHRR) imagery into geo-located and calibrated radiances, cloud masks, surface clear-sky broadband albedo, clear-sky skin temperatures, satellite viewing times, and viewing and solar geometry for the, high-latitude portions of the northern and southern hemispheres (all area north of 48N and south of 53S). AVHRR GAC data for August 1981 - July 1998 were acquired, with some gaps remaining, and processed into twice-daily 5-km grids, with some products also provided at 25-km resolution. AVHRR LAC data for 3.5 years of coverage in the northern hemisphere and 2.75 years of coverage in the southern hemisphere were processed into 1.25-km grids for the same suite of products. The resulting data sets are presently being transferred to the National Snow and Ice Data Center (NSIDC) for archiving and distribution. Using these data, researchers now have at their disposal an extensive AVHRR data set for investigations of high-latitude processes. In addition, the data lend themselves to development and testing of algorithms. The products are particularly relevant for climate research and algorithm development as applied to relatively long time periods and large areas.

Author

Calibrating; Geophysics; Polar Regions; Data Management; Data Processing

20000017951 Alaska Univ., Geophysical Inst., Fairbanks, AK USA

A Globally Integrated Substorm Model: Tail Reconnection and Magnetosphere-Ionosphere Coupling

Kan, J. R., Alaska Univ., USA; Journal of Geophysical Research; Jun. 01, 1998; ISSN 0148-0227; Volume 103, No. A6, pp. 11,787-11,795; In English

Contract(s)/Grant(s): F19628-96-C-0011; AF Proj. 4266

Report No.(s): AD-A369456; AFRL-VS-TR-1999-1509; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

We present a globally integrated substorm (GIS) model in which the patchy-bursty tail reconnection process at about 20-35 RE and the magnetosphere-ionosphere (M-I) coupling process form a global feedback system to cause substorms. We identify the necessary and sufficient conditions for the expansion onset in the near-Earth plasma sheet The neccessary condition far substorm onset is an abrupt convection braking in the Near-Earth plasma sheet at a rate is greater than or = about3 (mVjm)/RE, which is equivalent to dipolarizing the tail-like field at a rate is greater than or = about 0.5 nT/s. The sufficient condition requires the disrupted tail current to be carried away by the Alfven wave to form the substorm current wedge. These conditions must be satisfied by any onset mechanism. The Alfven wave launched by the dipolarization-induced electric field must carry away the disrupted tail about 10(exp 5) A/RE from the dipolarization region. As an example, we show that substorm expansion onset can be triggered by abruptly braking a bursty bulk flow of about 3 mV/m within about 1 RE. The disrupted tail current at the expansion onset is about 10(exp 5) A/RE carried away by the Allfven wave launched by the dipolarization-induced electric field of about 14 mV/m. Substorm expansion onset in the ionosphere occurs about 1 min later when the Alfven wave is reflected at the ionosphere. The dipolarization-induced tail reconnection and the M-I coupling farm a feedback system to power the ongoing expansion phase which typically lasts about 30 min. As the dipolarizing region expands tailward, the expansion phase into recovery phase when, the local tail current becomes too weak to sustain the expansion phase and the aurora activities start to retreat equatorward.

Author

Electric Fields; Ionospheric Currents; Magnetic Field Reconnection; Magnetohydrodynamic Waves; Magnetosphere-Ionosphere Coupling; Atmospheric Physics; Magnetospheric Instability; Traveling Ionospheric Disturbances

20000017994 Alabama Univ., Dept. of Civil and Environmental Engineering, Huntsville, AL USA

Shear Band Formation in Plane Strain Experiments of Sand

Alshibli, Khalid A., Alabama Univ., USA; Sture, Stein, Colorado Univ., USA; [1999]; 1p; In English

Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

A series of biaxial (plane strain) experiments were conducted on three sands under low (15 kPa) and high (100 kPa) confining pressure conditions to investigate the effects of specimen density, confining pressure, and sand grains size and shape on the constitutive and stability behavior of granular materials. The three sands used in the experiments were fine, medium, and coarse grained uniform silica sands with rounded, sub-angular, and angular grains, respectively. Specimen deformation was readily monitored and analyzed with the help of a grid pattern imprinted on the latex membrane. The overall stress-strain behavior is strongly dependent on the specimen density, confining pressure, sand grain texture, and the resulting failure mode(s). That became

evident in different degrees of softening responses at various axial strains. The relationship between the constitutive behavior and the specimens' modes of instability is presented. The failure in all specimens was characterized by two distinct and opposite shear bands. It was found that the measured dilatancy angles increase as the sand grains' angularity and size increase. The measured shear band inclination angles are also presented and compared with classical Coulomb and Roscoe solutions.
Author
Deformation; Plane Strain; Sands; Stress-Strain Relationships

20000019577 NASA Goddard Space Flight Center, Greenbelt, MD USA
Autonomous, Full-Time Cloud Profiling at Arm Sites with Micro Pulse Lidar
Spinhirne, James D., NASA Goddard Space Flight Center, USA; Campbell, James R., Science Systems and Applications, Inc., USA; Hlavka, Dennis L., Science Systems and Applications, Inc., USA; Scott, V. Stanley, NASA Goddard Space Flight Center, USA; Flynn, Connor J., Pacific Northwest National Lab., USA; [2000]; 4p; In English, 9-14 Jan. 2000, Long Beach, CA, USA; Sponsored by American Meteorological Society, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Since the early 1990's technology advances permit ground based lidar to operate full time and profile all significant aerosol and cloud structure of the atmosphere up to the limit of signal attenuation. These systems are known as Micro Pulse Lidars (MPL), as referenced by Spinhirne (1993), and were first in operation at DOE Atmospheric Radiation Measurement (ARM) sites. The objective of the ARM program is to improve the predictability of climate change, particularly as it relates to cloud-climate feedback. The fundamental application of the MPL systems is towards the detection of all significant hydrometeor layers, to the limit of signal attenuation. The heating and cooling of the atmosphere are effected by the distribution and characteristics of clouds and aerosol concentration. Aerosol and cloud retrievals in several important areas can only be adequately obtained with active remote sensing by lidar. For cloud cover, the height and related emissivity of thin clouds and the distribution of base height for all clouds are basic parameters for the surface radiation budget, and lidar is essetial for accurate measurements. The ARM MPL observing network represents the first long-term, global lidar study known within the community. MPL systems are now operational at four ARM sites. A six year data set has been obtained at the original Oklahoma site, and there are several years of observations at tropical and artic sites. Observational results include cloud base height distributions and aerosol profiles. These expanding data sets offer a significant new resource for cloud, aerosol and atmospheric radiation analysis. The nature of the data sets, data processing algorithms, derived parameters and application results are presented.
Author
Aerosols; Cloud Physics; Remote Sensing; Radiation Measurement; Optical Radar; Data Processing; Atmospheric Radiation

20000020784 Oslo Univ., Dept. of Physics, Norway
ISR Supplemented Studies of the CUSP and POLAR CAP *Final Report*
Egeland, Alv; Nov. 1999; 8p; In English
Contract(s)/Grant(s): F61776-99-WE001
Report No.(s): AD-A371004; EOARD-SPC-99-4001; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

This report results from a contract tasking University of Oslo as follows: The contractor will investigate the altitude range of the optical red line emission from noon aurorae, and also the transient upwelling of the thermosphere as a signature of transient entry of ionospheric plasma through the cusp into the polar cap night time ionosphere.
DTIC
Earth Ionosphere; Light Emission; Polar Caps; Auroras

20000020972 Swedish Inst. of Space Physics, Kiruna, Sweden
ENA Imaging of Planetary Magnetospheres
Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; ENA Imaging of Planetary Magnetospheres; October 1999; 70p; In English; See also 20000020971; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy

This PhD thesis deals with an observational technique within the field of magnetospheric physics which has become known as "energetic neutral atom (ENA) imaging". Wherever a plasma and a neutral gas coexists, ENAs will be produced through a charge exchange reaction. In most cases the ENAs will travel in straight lines away from the production point in the plasma, much like photons from an emitting source, and thus their detection allows the plasma to be imaged. to read, understand, and appreciate this thesis the reader should have a good knowledge of physics as taught the first years at undergraduate level and be familiar with basic plasma physics and concepts in space physics such as the solar wind, the magnetosphere and its fundamental regions. For

those not familiar with space plasma physics but with knowledge of university physics the following books can be recommended: Chen (1984), Kivelson and Russell (1995), Falthammar (1990).
Derived from text
Atmospheric Physics; Planetary Magnetospheres; Plasma Interactions; Imaging Techniques; Planetary Magnetic Fields

20000020973 Swedish Inst. of Space Physics, Kiruna, Sweden
Energetic Neutral Atom Imaging at Low Altitudes from the Swedish Microsatellite Astrid: Images and Spectral Analysis, Paper 1
Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Barabash, Stas, Swedish Inst. of Space Physics, Sweden; Norberg, Olle, Swedish Inst. of Space Physics, Sweden; Lundin, Rickard, Swedish Inst. of Space Physics, Sweden; Roelof, Rdmond C., Johns Hopkins Univ., USA; Chase, Christopher J., Bell Telephone Labs., Inc., USA; ENA Imaging of Planetary Magnetospheres; October 1999; 14p; Repr. from Journal of Geophysical Research, V. 104, no. A2, 1 Feb. 1999 p 2367-2379; In English; See also 20000020971; Original contains color illustrations
Contract(s)/Grant(s): NAGW-2619; NAGW-4729; Copyright; Avail: Issuing Activity, Hardcopy

Observations of energetic neutral atoms (ENA) in the energy range 26- 52 keV are reported from four occasions during geomagnetically disturbed periods. The data were acquired by the ENA imager flown on the Swedish microsatellite Astrid in a 1000 km circular orbit with 83 deg inclination. The ENA imager separates charged particles from neutrals through an electrostatic deflection system in the energy range between 0.1 and 114 keV. ENA images obtained from vantage points in the polar cap and in the afternoon magnetic local time (MLT) hours looking into the antisunward hemisphere show intense ENA fluxes (approx. 10(exp 4)/sq cm sr s over 26-37 keV) coming from the dusk region and low altitudes (approx. 300 km). The morphology shows no relation to local magnetic field excluding the possibility of charged particle detection. It is concluded that the source of these ENAs are precipitating/mirroring ions from the ring current/trapped radiation interacting with the exobase on auroral L-shells and in the dusk region. The observed ENA fluxes show a relation with KP and Dst geomagnetic indices. The observed ENA spectrum from a geomagnetic storm on February 8, 1995, is investigated in more detail and compared to the parent ion spectrum obtained by the Defense Meteorological Satellite Project (DMSP) satellite, Fl2, during the same period on L = 6 +/- 2 around dusk. The observed ENA spectral slope is used to derive the parent ion spectral temperature. The derived ion temperatures range is 3.0 - 6.0 keV for H and 4.5 - 8.5 keV for O. The higher of these ion temperatures comes closest in agreement to the extrapolated DMSP spectrum leading us to favor O over H as the species of the detected ENAS. It is shown that the detected ENAs must have been produced at L greater than or equal to 6 to reach the detector without atmospheric attenuation and that the main energy dependence of the ENA spectrum, apart from the parent ion spectrum, is governed by the energy dependence of the charge exchange cross section between ions and exospheric oxygen.
Author
Atmospheric Attenuation; Charged Particles; DMSP Satellites; Electrostatics; Imaging Techniques

20000020974 Swedish Inst. of Space Physics, Kiruna, Sweden
Energetic Neutral Atom Imaging at Low Altitudes from the Swedish Microsatellite Astrid: Extraction of the Equatorial Ion Distribution, Paper 2
Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Barabash, Stas, Swedish Inst. of Space Physics, Sweden; Roelof, Edmond C., Johns Hopkins Univ., USA; Chase, Christopher J., Bell Telephone Labs., Inc., USA; ENA Imaging of Planetary Magnetospheres; October 1999; 15p; In English; See also 20000020971
Contract(s)/Grant(s): NAGW-2619; NAGW-4729; Copyright; Avail: Issuing Activity, Hardcopy

Energetic neutral atom (ENA) images obtained by the ENA imager on- board the Astrid satellite in the polar cap at 1000 km during a moderate magnetic storm (Dst greater than or equal to 80 nT) on 8 February 1995 are simulated using a parameterized model of the equatorial ion distribution and a six-component Chamberlain exo-sphere with parameters from the MSISE-90 model. By changing the ion parameters until a matching ENA image is obtained one can extract the equatorial ion distribution. Four consecutive images from different view points several of minutes apart are simulated assuming H(+) and O(+), respectively, as parent ions. The optimal set of parameters is extracted by minimizing the chi(exp 2) difference between simulated and observed ENA image using Powell's minimization algorithm. The optimal equatorial model ion distribution consists of O(+) peaked in around dusk. The lower intensity of fluxes obtained from vantage points closer to the pole is an effect of the loss cone of the parent ion distribution being empty.
Author
Extraction; Imaging Techniques; Ion Distribution; Neutral Atoms; Low Altitude

20000020975 Swedish Inst. of Space Physics, Kiruna, Sweden

Energetic Neutral Atom Imaging at Low Altitudes from the Swedish Microsatellite Astrid: Observations at Low (Less Than or Equal to10 keV) Energies, Paper 3

Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Barabash, S., Swedish Inst. of Space Physics, Sweden; Roelof, Edmond C., Johns Hopkins Univ., USA; Chase, Christopher J., Bell Telephone Labs., Inc., USA; ENA Imaging of Planetary Magnetospheres; October 1999; 11p; In English; See also 20000020971; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy

Intense (10(exp 6)/ sq cm sr) fluxes of upflowing ENA from the polar cap have been observed in the energy range approx. 0.1 - 15 keV (hydrogen assumed) by the energetic neutral atom (ENA) imager PIPPI (Prelide In Planetary Particle Imaging) onboard the Astrid satellite at 1000 km altitude. If a source altitude of 400 km is assumed the ENA emissions maps to magnetic latitudes 70 deg-85 deg extending from dusk over nightside. There were no measurements in the midnight sector below approximately 80 deg. It is shown that the emissions cannot originate from an isotropically emitting source, which rules out any optical emissions. Local charged particle detection is ruled out on the basis of no correlation with local electron measurements and local magnetic field configuration. The ENA emissions can be explained by a conically pitch-angle distributed ion source emitting ENA in the 110 deg - 140 deg pitch-angle interval (source altitude 400 km). It is suggested, with support from low-altitude rocket observations that the ENA are produced by low-altitude (400-600 km)ion conics of several hundreds eV charge exchanging with the upper atmosphere.

Author

Neutral Atoms; Imaging Techniques; Angular Distribution; Ion Sources; Low Altitude

20000020976 Swedish Inst. of Space Physics, Kiruna, Sweden

Energetic Neutral Atom Imaging at Low (Less Than or Equal to 10 keV) Energies from Asrid: Observations and Simulations, Paper 4

Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Barabash, Stas, Swedish Inst. of Space Physics, Sweden; Wilson, Gordon R., Mission Research Corp., USA; Chase, Christopher J., Bell Telephone Labs., Inc., USA; ENA Imaging of Planetary Magnetospheres; October 1999; 7p; In English; See also 20000020971; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy

Intense (10(exp 6)/sq cm sr s) fluxes of upflowing ENA from the polar cap have been observed in the energy range 0.1 - 13 keV (hydrogen assumed) by the energetic neutral atom (ENA) imager PIPPI (Prelide In Planetary Particle Imaging) onboard the Astrid satellite at 1000 km altitude. If a source altitude of 400 km is assumed the ENA emissions maps to magnetic latitudes 70 deg - 85 deg extending from dusk over nightside. There were no measurements in the midnight sector below approximately 80 deg. Simulated images show that the observed emissions may be the ENA-albedo effect of the auroral ion precipitation. It is also possible that the observed emissions may originate from upward accelerated ions with cone-like pitch angle distributions charge exchanging.

Author

Neutral Atoms; Imaging Techniques; Ions; Auroras; Albedo

20000020977 Swedish Inst. of Space Physics, Kiruna, Sweden

Energetic Neutral Atom Imager on the Swedish Microsatellite Astrid, Paper 5

Barabash, S., Swedish Inst. of Space Physics, Sweden; Norberg, O., Swedish Inst. of Space Physics, Sweden; Roelof, E. C., Johns Hopkins Univ., USA; Lundin, R., Swedish Inst. of Space Physics, Sweden; Olsen, S., Swedish Inst. of Space Physics, Sweden; Lundin, K., Swedish Inst. of Space Physics, Sweden; Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Chase, C. J., Johns Hopkins Univ., USA; Mauk, B. H., Johns Hopkins Univ., USA; Koskinen, H., Finnish Meteorological Inst., Finland; Ryno, J., Finnish Meteorological Inst., Finland; ENA Imaging of Planetary Magnetospheres; October 1999; 5p; Repr. from Geophysical Monograph 103: Measurement Techniques in Space Plasmas: Fields (American Geophysical Union), 1998 p 257-261; In English; See also 20000020971

Contract(s)/Grant(s): NAGW-2619; NAGW-4729; Copyright; Avail: Issuing Activity, Hardcopy

The Swedish microsatellite ASTRID was launched by a Russian Cosmos rocket on January 24, 1995 into a 1000 km circular orbit with 83 deg inclination. Besides the main objective of technological demonstration, imaging of energetic neutral atoms (ENAS) was attempted. The imager detected ENA in the energy range 0.1 - 140 keV utilizing two different techniques. Neutrals of the energy 13 - 140 keV were recorded by 14 solid state detectors with the total field of view 5 deg x 322 deg. For half a spin (approx. 1.5 s) of the ASTRID spacecraft, almost all of space was covered with an angular resolution 2.5 deg x 25 deg. Less energetic neutrals of approx. 0.1 - 70 keV were converted on a graphite target into secondary particles which then were detected by a microchannel plate with 32 anodes. A fraction of primary neutrals was directly reflected towards the sensor. This technique

provided the total ENA flux with an angular resolution 4.6 deg x 11.5 deg. The instrument weight is 3.13 kg. Successful operation of the instrument during the first 5 weeks of the mission provided the first ENA images of the ring current at low altitudes.
Author
Neutral Atoms; Imaging Techniques; Ring Currents; Circular Orbits; Angular Resolution

20000020978 Swedish Inst. of Space Physics, Kiruna, Sweden
Energetic Neutral Atom Imaging at Mercury: Simulations and Instrument Requirements, Paper 6
Barabash, S., Swedish Inst. of Space Physics, Sweden; Lukyanov, A., Academy of Sciences (USSR), USSR; Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; Lundin, R., Swedish Inst. of Space Physics, Sweden; ENA Imaging of Planetary Magnetospheres; October 1999; 14p; In English; See also 20000020971; Original contains color illustrations
Contract(s)/Grant(s): RSAS-1242; Copyright; Avail: Issuing Activity, Hardcopy

The paper presents simulations of the energetic neutral atom (ENA) production in the Mercury magnetosphere and the obtained ENA images for the equatorial and polar vantage points. The ENA fluxes found to be 10(exp 2) - 10(exp 3)/sq cm s sr keV and up to 10(exp 4) - 10(exp 5)/ sq cm s sr keV in the energy range 10 - 50 keV. The ENA instrument requirements, 10 deg x 10 deg angular resolution and 20 sec accumulation time, can be easily met by modern ENA instrumentation. Therefore, ENA imaging of the Mercury magnetosphere is achievable. Due to the small size of the magnetosphere the particles injected in the tail can fill up the entire day side magnetosphere making possible ENA imaging of the magnetosphere shape. The high variability of the Hermean magnetosphere gives rise to pulsating ENA emissions (ENA ”flashes”) which can be used to study the global dynamics.
Author
Neutral Atoms; Imaging Techniques; Simulation

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification

20000015359 Massachusetts Inst. of Tech., Lab. of Electronics, Cambridge, MA USA
Polarimetric Microwave Remote Sensing of the Ocean Surface ***Annual Report, 1 Dec. 1998 - 30 Nov. 1999***
Kong, Jin A.; Dec. 21, 1999; 4p; In English
Contract(s)/Grant(s): N00014-99-1-0175
Report No.(s): AD-A371770; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The polarimetric passive techniques have been used for the retrieval of ocean wind speed and directions by measuring the polarimetric brightness temperature of the ocean surface. However, under high wind conditions, the presence of foam will significantly affect the brightness temperature signature of the plain ocean surface. In addition to the empirical model of the foam contribution to the thermal emission, the previous theoretical studies are mostly based on simple geometry models, which may not reflect the realistic physical situation.
DTIC
Polarimetry; Microwave Imagery; Marine Meteorology

20000015405 Air Force Research Lab., Space Vehicles Directorate, Hanscom AFB, MA USA
A Thunderstorm Prediction Technique Based on a Perfect-Prog Approach ***Interim Report, Oct. 1995 - Sep. 1998***
Bussey, Allan J.; Remeika, Michael F.; Newton, Brian; DeBenedictis, Daniel; Norquist, Donald C.; Feb. 1999; 114p; In English
Contract(s)/Grant(s): AF Proj. 4026
Report No.(s): AD-A371417; AFRL-VS-TR-1999-1529; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

We have developed a thunderstorm prediction technique for use with a mesoscale model to satisfy Air Force Weather’s Theater Battle Management (TBM) stated requirement for maximum cloud tops and coverage. The prediction technique is to be implemented in the Global Theater/Weather Analysis and Prediction System (GTWAPS). A perfect-prog approach was implemented using synoptic and subsynoptic-scale data for diagnosis and short-range probability forecasts. Future work is discussed, including, most importantly, follow-on testing and refinements of the technique.
DTIC
Weather; Predictions; Thunderstorms; Management; Weather Forecasting; Prediction Analysis Techniques; Cloud Height Indicators

20000017995 NASA Marshall Space Flight Center, Huntsville, AL USA

Regional Differences in Tropical Lightning Distributions

Boccippio, D. J., NASA Marshall Space Flight Center, USA; Goodman, S. J., NASA Marshall Space Flight Center, USA; Heckman, S., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Observations from the TRMM-based Lightning Imaging Sensor are analyzed for variability between land and ocean, geographic regions and different (objectively-defined) convective ”regimes”. The bulk of the order-of-magnitude differences between land and ocean regional flash rates are accounted for by differences in storm spacing (density) rather than differences in storm flash rates, which only vary by a factor of two on average. Combined with characteristic differences in land/ocean updraft velocities, this strongly suggests that possible lightning-updraft relationships are closer to linearity than strong nonlinearity (contradicting earlier hypotheses). Regional variability in cell density and cell flash rates closely tracks differences in 85 GHz microwave brightness temperatures. Monotonic relationships are found with the gross moist stability of the tropical atmosphere, a large scale ”adjusted state” parameter. This strongly suggests that it will be possible, using TRMM observations, to objectively test numerical or theoretical predictions of how mesoscale convective organization interacts with the larger scale environment. Further parameters are suggested for a complete objective definition of tropical convective ”regimes”.

Author

Lightning; Tropical Regions; Convection Currents; Equatorial Atmosphere; Tropical Meteorology; Air Land Interactions; Air Water Interactions

20000018004 Washington Univ., Applied Physics Lab., Seattle, WA USA

Wind Forcing of the Pacific Ocean Using Scatterometer Wind Data ***Final Report, 7 Apr. 1997 - 31 Dec. 1999***

Kelly, Kathryn A., Washington Univ., USA; 1999; 12p; In English; Original contains color illustrations

Contract(s)/Grant(s): JPL-960927; JPL-960731; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The long-term objective of this research was an understanding of the wind-forced ocean circulation, particularly for the Pacific Ocean. to determine the ocean’s response to the winds, we first needed to generate accurate maps of wind stress. For the ocean’s response to wind stress we examined the sea surface height (SSH) both from altimeters and from numerical models for the Pacific Ocean.

Derived from text

Atmospheric Circulation; Ocean Surface; Pacific Ocean; Sea Level; Wind (Meteorology); Wind Effects; Tropical Regions

20000019564 NASA Marshall Space Flight Center, Huntsville, AL USA

Dry Air Entrainment into Hurricane Earl

Guillory, Anthony R., NASA Marshall Space Flight Center, USA; Jedlovec, Gary J., NASA Marshall Space Flight Center, USA; Atkinson, Robert J., Lockheed Martin Corp., USA; Hood, Robbie E., NASA Marshall Space Flight Center, USA; LaFontaine, Frank J., Raytheon ITSS, USA; [2000]; 1p; In English; Geoscience and Remote Sensing, 24-28 Jul. 2000, Honolulu, HI, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Hurricane Earl formed in the Gulf of Mexico in September 1998. It quickly was upgraded from a tropical disturbance to tropical storm status and then to a hurricane. Earl possessed hybrid (tropical and extratropical) characteristics throughout its lifetime. The system maintained and erratic track, which led to wide variability in the operational track forecasts. It eventually made landfall on the Florida panhandle on 2 September and raced northeastward. During August and September 1998, NASA conducted the third Convection and Moisture Experiment (CAMEX-3). The experiment was focused on studying hurricanes with an emphasis toward developing a better understanding of their intensification and motion. Earl provides a unique opportunity to utilize high spatial and temporal resolution data collected from the DC-8 and high altitude ER-2 NASA platforms, which flew over Earl as it made landfall. These data can also be put into broader view provided by other instruments from the Geosychronous Operational Environmental Satellites (GOES) and the Tropical Rainfall Measuring Mission (TRMM) satellites. Hurricane Earl was affected by entrainment of dry air from the northwest. Hurricane ISIS was intensifying and approaching the Mexican Pacific coast with its associated outflow potentially affecting the inflow into Earl as the storm neared Florida. In addition, a longwave synoptic trough circulation was present over the eastern U.S. Either or both of these could be responsible for the dry air into the system. This paper will focus on identifying the source of the dry by using upper-level wind and moisture fields derived from the GOES 6.7 um water vapor imagery. We will attempt to relate the large-scale observations to those from the NASA aircraft. An infrared instrument onboard the ER-2 also has a similar wavelength and may be able to confirm some of the GOES findings. In addition, a microwave radiometer with 4 channels focused on measuring precipitation and its associated ice scattering was also

aboard the ER-2. The microwave observations will allow the authors to relate the entrainment to precipitation changes near the flight path of the aircraft.
Author
Hurricanes; Tropical Regions; Meteorology; Climatology; Tropical Meteorology

20000019570 NASA Marshall Space Flight Center, Huntsville, AL USA
Combined Satellite and Surface-Based Estimation of the Intracloud/ Cloud-to-Ground Lightning Ratio Over the Continental USA
Boccippio, D. J., NASA Marshall Space Flight Center, USA; Cummins, K., NASA Marshall Space Flight Center, USA; Christian, H. J., NASA Marshall Space Flight Center, USA; Goodman, S. J., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Four years of observations from the NASA Optical Transient Detector (OTD) and Global Atmospherics National Lightning Detection Network (NLDN) are combined to determine the geographic distribution of the intracloud/cloud to ground lightning ratio over the continental USA. The mean ratio over this region is 2.64-2.94, with a standard deviation of 1.1-1.3 and anomalies as low as 1.0 or less over the Rocky and Appalachian mountains and as high as 8-10 in the central-upper midwest. There is some indication that the ratio covaries with ground elevation, although the relationship is nonunique. Little evidence is found to support a latitudinal covariance, despite significant variation in the climatological mean tropopause pressure over the latitudes considered. The dynamic range of local variability is comparable to the range of values cited by previous studies for latitudinal variation from the deep tropics to midlatitudes. Local high anomalies of this ratio in the midwest are coincident with anomalies in the climatological percentage of positive CG occurrence, as well as in the occurrence of large positive CGs characteristic of MCS convective and trailing stratiform regions. This suggests that storm type, morphology and level of organization may dominate over environmental cofactors in the local determination of this ratio.
Author
Climatology; Cloud-to-Ground Discharges; Geographic Distribution; Cloud-to-Cloud Discharges; Atmospheric Electricity; Meteorology

20000019571 NASA Goddard Space Flight Center, Greenbelt, MD USA
Coherent Modes of Global SST and Summer Rainfall over China: An Assessment of the Regional Impacts of the 1997-98 El Nino/ La Nina*, 1997-1998*
Lau, K.-M., NASA Goddard Space Flight Center, USA; Weng, Hengyi, General Sciences Corp., USA; Dec. 03, 1999; 37p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, we have identified three principal modes of summertime rainfall variability over China and global sea surface temperature (SST) for the period 1955-1998. Using these modes, we have assessed the impact of the El Nino/La Nina on major drought and flood occurrence over China during 1997-1998. The first mode can be identified with the growth phase of El Nino superimposed on a linear warming trend since the mid-1950s. This mode strongly influences rainfall over northern China. The second mode comprises of a quasi-biennial tendency manifested in alternate wet and dry years over the Yangtze River Valley (YRV) of central China. The third mode is dominated by a quasi-decadal oscillation in eastern China between the Yangtze River and the Yellow River. Using a mode-by-mode reconstruction, we evaluate the impacts of the various principal modes on the 1997 and 1998 observed rainfall anomaly. We find that the severe drought in northern China, and to a lesser degree the flood in southern China, in 1997 is likely a result of the influence of anomalous SST forcing during the growth phase of the El Nino. In addition, rainfall in southern China may be influenced by the decadal or long-term SST variability. The severe flood over the Yangtze River Valley in 1998 is associated with the biennial tendency of basin scale SST during the transition from El Nino to La Nina in 1997-98. Additionally, the observed prolonged drought over northern China and increasing flooding over the YRV since the 1950s may be associated with a long-term warming trend in the tropical Indian and western Pacific ocean. During 1997, the El Nino SST exacerbated the drought situation over northern China. In 1998, the drought appeared to get temporary relief from the La Nina anomalous SST forcing.
Author
China; Sea Surface Temperature; Summer; Rain; Periodic Variations; Variability; El Nino

20000019588 NASA Marshall Space Flight Center, Huntsville, AL USA

Entrainment of Upper Level Dry Air Into Hurricane Earl

Guillory, Anthony R., NASA Marshall Space Flight Center, USA; Jedlovec, Gary J., NASA Marshall Space Flight Center, USA; Hood, Robbie E., NASA Marshall Space Flight Center, USA; Atkinson, Robert J., Lockheed Martin Corp., USA; LaFontaine, Frank J., Raytheon Co., USA; [1999]; 1p; In English; 24th; Hurricanes and Tropical Meteorology, 29 May - 2 Jun. 2000, Fort Lauderdale, FL, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Hurricane Earl formed in the Gulf of Mexico in September 1998. It quickly was upgraded from a tropical disturbance to tropical storm status and then to a hurricane. Earl possessed hybrid (tropical and extratropical) characteristics throughout its lifetime. The system maintained and erratic track, which led to wide variability in the operational track forecasts. It eventually made landfall on the Florida panhandle on 2 September and raced northeastward. During August and September 1998, NASA conducted the third Convection and Moisture Experiment (CAMEX-3). The experiment was focused on studying hurricanes with an emphasis toward developing a better understanding of their intensification and motion. Earl provides a unique opportunity to utilize high spatial and temporal resolution data collected from the DC-8 and high altitude ER-2 NASA platforms, which flew over Earl as it made landfall. These data can also be put into broader view provided by other instruments from the Geosynchronous Operational Environmental Satellites (GOES) and the Tropical Rainfall Measuring Mission (TRMM) satellites. Hurricane Earl was affected by entrainment of dry air from the northwest. Hurricane ISIS was intensifying and approaching the Mexican Pacific coast with its associated outflow potentially affecting the inflow into Earl as the storm neared Florida. In addition, a longwave synoptic trough circulation was present over the eastern U.S. Either or both of these could be responsible for the dry air into the system. This paper will focus on identifying the source of the dry by using upper-level wind and moisture fields derived from the GOES 6.7 um water vapor imagery. We will attempt to relate the large-scale observations to those from the NASA aircraft. An infrared instrument onboard the ER-2 also has a similar wavelength and may be able to confirm some of the GOES findings. In addition, a microwave radiometer with 4 channels focused on measuring precipitation and its associated ice scattering was also aboard the ER-2. The microwave observations will allow the authors to relate the entrainment to precipitation changes near the flight path of the aircraft.

Author

Entrainment; Upper Atmosphere; Dry Heat; Hurricanes; Atmospheric Circulation; Tropical Meteorology; Trmm Satellite; Tropical Regions

20000019641 National Severe Storms Lab., Norman, OK USA

The Distance Between Successive Lightning Flashes

Lopez, Raul E., National Severe Storms Lab., USA; Holle, Ronald L., National Severe Storms Lab., USA; September 1999; 40p; In English

Report No.(s): PB2000-101064; NOAA-TM-ERL-NSSL-105; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The distribution of the distance between successive cloud-to-ground (CG) flashes has been studied for storms in several regions of the USA. This information is useful for the understanding of several aspects of lightning phenomenology. It is particularly important for personal safety strategies, so that a person can estimate the likelihood that the next flash could be a personal threat. The study concentrates on this application. Use was made of the National Lightning Detection System (NLDN) database.

NTIS

Cloud-to-Ground Discharges; Phenomenology

20000019649 NASA Marshall Space Flight Center, Huntsville, AL USA

A Diagnostic Analysis of the Kennedy Space Center LDAR Network, 1, Data Characteristics

Boccippio, D. J., NASA Marshall Space Flight Center, USA; Heckman, S., NASA Marshall Space Flight Center, USA; Goodman, S. J., NASA Marshall Space Flight Center, USA; [1999]; 2p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

An analytical framework is developed in which to analyze climatological VHF (66 MHz) radiation measurements taken by the Kennedy Space Center Lightning Detection and Ranging (LDAR) network. A 19-month noise-filtered sample of LDAR observations is examined using this framework. It is found that the climatological VHF source density as observed by LDAR falls off approximately 10 dB every 71 km of ground range away from the network centroid (a 31 km e-folding scale). From this framework it is inferred that the underlying source distribution is likely inverse exponential in amplitude, with a log-slope of 126-147 mW(sup -1/2). The underlying vertical distribution of VHF sources is approximately normally distributed with a mean altitude of 9 km and a standard deviation of 2.7 km; this implies that the loss of below-horizon sources has a negligible effect on column-integrated source densities within 200 km ground range. At medium to far ranges, location errors are primarily radial and

have a slightly asymmetric distribution whose first moment increases as range squared. Error moments estimated from observed lightning are significantly higher than those from aircraft-based signal generator or analytic solution estimates, suggesting that timing errors arising from poor signal identification and discrimination may dominate over timing errors arising from nominal sensor resolution. The VHF source properties of individual LDAR-observed flashes are computed and an analytic expression for flash detection efficiency vs. range is derived. This reveals nearly constant flash detection efficiency to 80-94 km range from the network centroid.
Author
Detection; Very High Frequencies; Rangefinding; Laser Ranger/Tracker; Radar Measurement; Radar Tracking

20000019650 NASA Marshall Space Flight Center, Huntsville, AL USA
A Diagnostic Analysis of the Kennedy Space Center LDAR Network, 2, Cross-Sensor Studies
Boccippio, D. J., NASA Marshall Space Flight Center, USA; Heckman, S., NASA Marshall Space Flight Center, USA; Goodman, S. J., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Range dependencies in total (intracloud and cloud-to-ground) lightning observed by the Kennedy Space Center Lightning Detection and Ranging (LDAR) network are established through cross-comparison with other lightning sensors. Using total lightning observed by the Lightning Imaging Sensor (LIS), LDAR flash detection efficiency is shown to remain above 90% out to 90-100 km range, and to be below 25% at 200 km range. LDAR VHF source location error distributions are also determined as a function of range, and are found to be asymmetric with first moments increasing roughly as range squared. Range normalization schemes for total VHF source density are tested and shown to yield significant (up to 50%) skill improvements over uncorrected data, when compared with National Lightning Detection Network (NLDN) ground flash counts at hourly, daily, monthly and climatological time scales.
Author
Detection; Cloud-to-Ground Discharges; Intracloud Discharges; Position (Location)

20000020926 NASA Goddard Space Flight Center, Greenbelt, MD USA
Rainfall Morphology in Semi-Tropical Convergence Zones
Shepherd, J. Marshall, NASA Goddard Space Flight Center, USA; Ferrier, Brad S., Maryland Univ. Baltimore County, USA; Ray, Peter S., Florida State Univ., USA; [2000]; 62p; In English; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Central Florida is the ideal test laboratory for studying convergence zone-induced convection. The region regularly experiences sea breeze fronts and rainfall-induced outflow boundaries. The focus of this study is the common yet poorly-studied convergence zone established by the interaction of the sea breeze front and an outflow boundary. Previous studies have investigated mechanisms primarily affecting storm initiation by such convergence zones. Few have focused on rainfall morphology yet these storms contribute a significant amount precipitation to the annual rainfall budget. Low-level convergence and mid-tropospheric moisture have both been shown to correlate with rainfall amounts in Florida. Using 2D and 3D numerical simulations, the roles of low-level convergence and mid-tropospheric moisture in rainfall evolution are examined. The results indicate that time-averaged, vertical moisture flux (VMF) at the sea breeze front/outflow convergence zone is directly and linearly proportional to initial condensation rates. This proportionality establishes a similar relationship between VMF and initial rainfall. Vertical moisture flux, which encompasses depth and magnitude of convergence, is better correlated to initial rainfall production than surface moisture convergence. This extends early observational studies which linked rainfall in Florida to surface moisture convergence. The amount and distribution of mid-tropospheric moisture determines how rainfall associated with secondary cells develop. Rainfall amount and efficiency varied significantly over an observable range of relative humidities in the 850- 500 mb layer even though rainfall evolution was similar during the initial or ”first-cell” period. Rainfall variability was attributed to drier mid-tropospheric environments inhibiting secondary cell development through entrainment effects. Observationally, 850-500 mb moisture structure exhibits wider variability than lower level moisture, which is virtually always present in Florida. A likely consequence of the variability in 850-500 moisture is a stronger statistical correlation to rainfall, which observational studies have noted. The study indicates that vertical moisture flux forcing at convergence zones is critical in determining rainfall in the initial stage of development but plays a decreasing role in rainfall evolution as the system matures. The mid-tropospheric moisture (e.g. environment) plays an increasing role in rainfall evolution as the system matures. This suggests the need to improve measurements of magnitude/depth of convergence and mid-tropospheric moisture distribution. It also highlights the need for better parameterization of entrainment and vertical moisture distribution in larger-scale models.
Author
Rain; Morphology; Tropical Regions; Temperate Regions; Moisture; Troposphere

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.

20000019646 Continental Shelf Associates, Jupiter, FL USA
Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program: Ecosystem Monitoring, Mississippi/Alabama Shelf *Interim Report*
Oct. 1999; 242p; In English
Report No.(s): PB2000-102478; No Copyright; Avail: CASI; A03, Microfiche; A11, Hardcopy

This Annual Interim report summarizes the third year (Phase 3) of a four-year program to characterize and monitor hard bottom features on the Mississippi/Alabama outer continental shelf. Phase 3 included the last of four monitoring cruises that revisted nine sites. Cruise M4 was conducted in two legs, in April 1999 and July-August 1999. Two mooring servicing cruises also were conducted, in October 1998 and January-February 1999. Monitoring program components included geological characterization, sediment dynamics, geochemistry, physical oceanography and hydrography, hard bottom communities, fish communities, and two companion studies (micro-habitat studies and epibiont recruitment). For each component, the report presents study retionale, field and laboratory methods, results to date, and discussion.
NTIS
Environmental Monitoring; Continental Shelves; Mexico; Ocean Dynamics; Marine Environments

20000020892 Delaware Univ., Center for the Study of Marine Policy, Newark, DE USA
Trends and Future Challenges for US National Ocean and Coastal Policy: Proceedings of a Workshop. Addendum to the Proceedings
Cicin-Sain, B.; Knecht, R. W.; Foster, N.; Aug. 1, 1999; 192p; In English; Trends and Future Challenges for US National Ocean and Coastal Policy, 22 Jan. 1999, Washington, DC, USA
Report No.(s): PB2000-101823; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of the conference was to examine trends and future challenges (national and global) that are likely to affect U.S. national ocean and coastal policy in the next 25 years. Such trends include demographic pressures on the coast; trends related to resource scarcity; technological and industry-driven innovations; changes in social values and attitudes; changes in environmental and domestic governance frameworks; and changes in ocean industries. The meeting agenda is included in the Appendix.
NTIS
Conferences; Trends; Oceans; Policies; Environment Management; Biotechnology

20000020930 Naval Postgraduate School, Monterey, CA USA
Ionian Sea Surface Temperature: Satellite and Drifter Observations, May to October, 1995
Leitz, Jeffrey M.; Sep. 1999; 105p; In English
Report No.(s): AD-A371279; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Ionian Sea is the central basin of the Mediterranean Sea and has been the subject of various oceanographic studies since the 19th century. Substantial changes in water properties (such as temperature), both spatially and temporally (seasonal) occur as a result of extreme forcings by the local winds and by the inflow of cool and less saline Atlantic waters. In recent years, extensive measurements have been made, primarily through remote sensing techniques. In particular, satellite infrared data were used to study the surface thermal features and associated circulation. In order to improve upon previous results, this study focuses on a period of 6 months (May to October, 1995) in which the full resolution (1.25x1.25 km) satellite images are used to describe and study the variability of the sea surface temperature (S ST) and circulation from meso- (days) to seasonal (months) scales. The satellite infrared temperatures are compared to simultaneous and collocated in-situ drifter temperature measurements. They are corrected by removing biases obtained by regression analysis. The corrected images are used to produce maps representing daily, three-day, weekly and monthly Ionian SSTs. Selected SST composites augmented with drifter track and wind field overlays disclose important quantitative features of the Ionian surface waters, such as upwelling events in the Straits of Otranto and of Sicily, and off the African Coast. The spatial structure and temporal variability of the surface fields are presented and discussed.
DTIC
Oceanography; Temperature Distribution; Temperature Measurement; Mediterranean Sea; Remote Sensors; Surface Water

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.

20000018023 California Univ., Section of Neurobiology, Physiology, and Behavior, Davis, CA USA
Development of the Circadian Timing System in Rat Pups Exposed to Microgravity during Gestation
Fuller, Charles A., California Univ., USA; [2000]; 43p; In English
Contract(s)/Grant(s): NCC2-886; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ten pregnant Sprague Dawley rat dams were exposed to spaceflight aboard the Space Shuttle (STS-70) for gestational days 11-20 (G 11-20; FILT group). Control dams were maintained in either a flight-like (FIDS group) or vivarium cage environment (VIV group) on earth. All dams had ad lib access to food and water and were exposed to a light-dark cycle consisting of 12 hours of light (- 30 lux) followed by 12 hours of darkness. The dams were closely monitored from G 22 until parturition. All pups were cross-fostered at birth; each foster dam had a litter of 10 pups. Pups remained with their foster dam until post-natal day 21 (PN 21). Pup body mass was measured twice weekly. At PN14 FILT pups had a smaller body mass than did the VIV pups (p is less than 0.01). Circadian rhythms of body temperature and activity of pups from two FILT dams (n = 8), two FIDS dams (n = 9) and two VIV dams (n = 7) were studied starting from age PN 21. All pups had circadian rhythms of temperature and activity at this age. There were no significant differences in rhythms between groups that could be attributed to microgravity exposure. We also examined the development of neural structures involved in circadian rhythmicity: the retina, the intergeniculate leaflet (IGL) and the circadian pacemaker, the suprachiasmatic nucleus (SCN). There were small differences between the flight and control groups at very early stages of development (G 20 and PN3) which indicated that the development of both the SCN and the IGL. These results indicate that exposure to the microgravity environment of spaceflight during this embryonic development period does not affect the development of the circadian rhythms of body temperature and activity, but may affect the early development of the neural structures involved in circadian timing.
Derived from text
Circadian Rhythms; Microgravity; Rats; Fetuses; Embryology; Activity Cycles (Biology); Embryos; Pregnancy

20000020485 Universities Space Research Association, Div. of Space Life Sciences, Houston, TX USA
Proceedings of the First Biennial Space Biomedical Investigators' Workshop
Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999; 692p; In English; First Biennial Space Biomedical Investigators' Workshop, 11-13 Jan. 1999, League City, TX, USA; See also 20000020486 through 20000020688
Contract(s)/Grant(s): NCC9-41; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The First Biennial Space Biomedical Investigators' Workshop, held January 11-13, 1999, was unique in that it assembled, for the first time, a broad cross section of NASA-funded biomedical researchers to present the current status of their projects and their plans for future investigations. All principal investigators with active, or recently-completed ground-based projects in NASA's Biomedical Research and Countermeasures Program that were funded through NASA's Office of Life and Microgravity Sciences and Applications were invited. Included were individual investigators funded through NASA Research Announcements, investigators with NASA Specialized Centers of Research and Training, investigators with the recently established National Space Biomedical Research Institute (NSBRI), and NASA civil servant investigators. Seventy-seven percent of all eligible projects were presented at the workshop. Thus, these Proceedings should provide a useful snapshot of the status of NASA-funded space biomedical research as of January 1999. An important workshop objective was to achieve free and open communication among the presenting investigators. Therefore, presentation of new and incomplete results, as well as hypotheses and ideas for future research, was encouraged. Comments and constructive criticisms from the presenters' colleagues were also encouraged. These ground rules resulted in many lively and useful discussions, during both the presentation sessions and informal evening gatherings and breaks.
Author
Conferences; Life Sciences; Cardiovascular System; Immunology; Musculoskeletal System; Microgravity; Activity (Biology)

20000020487 NASA, Washington, DC USA

Life Sciences in NASA's Mission

Nicogossian, Arnauld E., NASA, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 4-11; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The topics of agency and enterprise goals, OLMSA organization, life sciences relationship to NASA/HEDS strategic plans, budget allocated by the HEDS strategic plan goals, 1998 successes, exploration and the International Space Station, congressional budgets, OLMSA grants, biomedical research and countermeasures, medical care, biologically inspired technologies, and publication, education and outreach are all presented in viewgraph form.

CASI

Life Sciences; Gravitational Effects; Bioastronautics; Activity (Biology)

20000020488 NASA Johnson Space Center, Houston, TX USA

JSC, NASA Lead Center: Overview of Human Space Life Sciences Programs Office (HSLSPO)

Stegemoeller, Charles, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 12-18; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

An overview of the Human Space Life Sciences Programs Office (HSLSPO) presents the following topics in viewgraph form: Agency structure, objectives of the HSLSPO lead center implementation plan, HSLSPO relationship to Johnson Space Center (JSC) as lead center, HSLSPO programs and projects, biomedical research and countermeasures, HSLSPO relationship to the International Space Station (ISS), and BR&C ISS flight research content.

CASI

Life Sciences; NASA Space Programs; Organizations

20000020489 NASA Johnson Space Center, Houston, TX USA

The Human Space Life Sciences Critical Path Roadmap Project: A Strategy for Human Space Flight through Exploration-Class Missions

Sawin, Charles F., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 19-37; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The product of the critical path roadmap project is an integrated strategy for mitigating the risks associated with human exploration class missions. It is an evolving process that will assure the ability to communicate the integrated critical path roadmap. Unlike previous reports, this one will not sit on a shelf - it has the full support of the JSC Space and Life Sciences Directorate (SA) and is already being used as a decision making tool (e.g., budget and investigation planning for Shuttle and Space Station mission). Utility of this product depends on many efforts, namely: providing the required information (completed risk data sheets, critical question information, technology data). It is essential to communicate the results of the critical path roadmap to the scientific community - this meeting is a good opportunity to do so. The web site envisioned for the critical path roadmap will provide the capability to communicate to a broader community and to track and update the system routinely.

Author

Life Sciences; Information Systems; Aerospace Engineering; Management Planning

20000020490 NASA Johnson Space Center, Houston, TX USA

NASA Johnson Space Center Biomedical Research Resources

Paloski, W. H., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 38-45; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Johnson Space Center (JSC) medical sciences laboratories constitute a national resource for support of medical operations and life sciences research enabling a human presence in space. They play a critical role in evaluating, defining, and mitigation the untoward effect of human adaption to space flight. Over the years they have developed the unique facilities and expertise required to perform: biomedical sample analysis and physiological performance tests supporting medical evaluations of space flight crew members and scientific investigations of the operationally relevant medical, physiological, cellular, and biochemical issues associated with human space flight. A general overview of these laboratories is presented in viewgraph form.

CASI

Medical Science; Laboratories; Research Facilities

20000020491 NASA Ames Research Center, Moffett Field, CA USA

Hypergravity Facilities: Extending Knowledge Over the Continuum of Gravity

Souza, Kenneth A., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 46-56; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Historical perspectives, reasons for gravitational research, key questions regarding centrifuges, particular centrifuge discussions, vestibular research facilities, the hypergravity facility for cell culture, the human research facility, as well as the center for bioinformatics are all topics discussed in viewgraph form.

CASI

High Gravity Environments; Research Facilities; Human Centrifuges

20000020492 California Univ., Dept. of Physiology and Biophysics, Irvine, CA USA

Task Force Report on Countermeasures, February 1997

Baldwin, Kenneth M., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 57-70; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The subgroup and discipline consensus concerning: (1) define (nasa program management) the fitness standards and/or levels of acceptance of physiological homeostasis relative to the 1 g environment; (2) review and improve astronaut diets to insure adequate caloric intake and appropriate compatibility for mineral balance; (3) modify the exercise prescription, which should also impact cardiovascular homeostasis, to focus more on muscle and bone conservation; (4) numerous disciplines strongly endorse the development of a human-powered gravity cycle; (5) integrate research and operational medical issues into the countermeasures plan; and (6) design countermeasure strategies that are effective, integrative, and appealing to insure astronaut compliance.

Derived from text

Standards; Fitness; Cardiovascular System; Compatibility; Countermeasures; Gravitation; Homeostasis; Physical Exercise

20000020493 National Academy of Sciences - National Research Council, Committee on Space Biology and Medicine, Washington, DC USA

A Strategy for Research in Space Biology and Medicine in the New Century

Osborn, Mary Jane, National Academy of Sciences - National Research Council, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 71-79; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Physiological and psychological effect of spaceflight are: 1. Loss of weight-bearing bone and muscle: (1) studies should provide mechanistic Insights into development of effective countermeasures against bone and muscle deterioration during and after flight; (2) ground-based model systems should be used to investigate mechanisms of changes; (3) a database on the natural history of the microgravity-related bone loss and its reversibility In humans should be established in preflight, inflight and postflight recordings of bone mineral density; (4) hormone profiles should be obtained on humans before, during and following spaceflight; and (5) the relationship should be Investigated between exercise activity levels and protein energy balance inflight. 2. Vestibular function, the vestibular ocular reflex and sensorimotor integration: (1) highest priority should be given to experiments to determine the basis for compensatory mechanisms on earth and in space; (2) inflight recordings of signal processing following otolith afferent stimulation should be made by a trained physiologist serving as payload specialist; and (3) future studies should determine if and how exposure to microgravity affects mechanisms whereby new motor patterns are learned In response to sensory perturbations.

Derived from text

Research; Aerospace Medicine; Afferent Nervous Systems; Bone Demineralization; Countermeasures; Physiological Effects; Vestibules

20000020494 NASA Johnson Space Center, Houston, TX USA

Human Health and Performance Aspects of Mars Design Reference Mission of July, 1997

Charles, John B., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 80-93; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The human element is the most complex element of the mission design Mars missions will pose significant physiological and psychological challenges to crew members Some challenges (human engineering, life support) must be overcome (potential "non-starters") Some challenges (bone, radiation) may be show-stoppers ISS will only Indirectly address Mars questions before

any ”Go/No Go” decision Significant amount of ground-based and specialized flight research will be required -- Critical Path Roadmap project will direct HSLSPO’s research toward Mars exploration objectives
Author
Human Performance; Human Factors Engineering; Health; Physiology

20000020495 Massachusetts Inst. of Tech., Apollo Program, Cambridge, MA USA
National Space Biomedical Research Institute
Young, Laurence R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 94-99; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Mission Implementation Involves: developing countermeasures; defining and integrating the molecular, cellular, organ-level and whole-body responses to space flight; establishing and developing appropriate biomedical support technologies; transferring advances in knowledge and technology to the benefit of mankind in space and on earth; and ensuring open involvement in the Institute’s activities.
Author
Countermeasures; Technology Assessment; Human Behavior

20000020501 NASA Johnson Space Center, Houston, TX USA
Barophysiology and Biophysics
Powell, Michael R., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 127-131; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Decompression is an important aspect of extravehicular activity (EVA). Errors can result in decompression sickness (DCS) if the protective measures are too liberal, while valuable on-orbit time is dissipated in prophylactic methodologies that are excessively conservative. Nucleation is an important consideration in many natural events, and its control is very important in many industrial procedures. The amount of Extravehicular Activity (EVA) that will be required during the construction of the International Space Station exceeds all of the other activity combined. The requirements in astronaut time and consumables (breathing oxygen and air) will be considerable. In an attempt to mitigate these requirements, Project ARGO was investigated in 1990 to investigate the effects of gravitational forces on the musculoskeletal system. This work has led to the present plans for the reduction of prebreathe duration. Over the past decade, research has been directed towards an understanding of the biophysical basis of the formation and growth of the decompression gas phase with the goal of improving the efficiency of the EVA process. In the past, we have direct work towards a more complete understanding of gas bubble formation and growth and exercise-enhanced washout during oxygen prebreathe.
Author
Biophysics; Decompression Sickness; Extravehicular Activity; Pressure Reduction; Physical Exercise; Oxygen; Musculoskeletal System; Gravitational Fields

20000020520 California Univ., San Diego, Dept. of Bioengineering, La Jolla, CA USA
Femoral Vein Ligation Increases Bone Mass in the Hindlimb Suspended Rat
Bergula, A. P., California Univ., San Diego, USA; Huang, W., California Univ., San Diego, USA; Frangos, J. A., California Univ., San Diego, USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 194-197; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Bone remodeling in response to changing mechanical demands is well recognized. While it is generally accepted that the local mechanical environment contributes to the physiological maintenance of bone, several studies have suggested a role for interstitial fluid flow (IFF) in bone remodeling. Bone contains a porous network of canaliculi that has been shown to facilitate substantial and rapid transcortical IFF. Flow is steady in the absence of mechanical strain, but bending or compressive loads create pressure gradients which drive fluid from areas of compression to areas of tension. In vitro investigations of flow effects on bone demonstrate that fluid shear rapidly stimulates the release of nitric oxide and prostaglandin E(sub 2), two autocrine/paracrine factors associated with remodeling. These results suggest that the fluid shear stresses induced by increased IFF in bone may stimulate bone growth. Consequently, it has been hypothesized that changes in IFF due to intraosseous pressure changes influence bone remodeling. The goal of this study was to investigate the role of IFF in bone in vivo; the effect of venous ligation as a means to increase intramedullary pressure and IFF was observed in a model independent of mechanical strain, the hindlimb suspended rat.
Author
Bones; Compression Loads; IFF Systems (Identification); Physiology; Prostaglandins; Veins

20000020521 NASA Ames Research Center, Moffett Field, CA USA

The Effect of Skeletal Unloading on Bone Formation: Role of IGF-I

Bikle, D. D., Veterans Affairs Medical Center, USA; Kostenuik, P., Veterans Affairs Medical Center, USA; Holton, E. M., NASA Ames Research Center, USA; Halloran, B. P., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 198-199; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The best documented change in bone during space flight is the near cessation of bone formation. Space flight leads to a decrease in osteoblast number and activity, likely the result of altered differentiation of osteoblast precursors. The net result of these space flight induced changes is weaker bone. To understand the mechanism for these changes poses a challenge. Space flight studies must overcome enormous technical problems, and are necessarily limited in size and frequency. Therefore, ground based models have been developed to evaluate the effects of skeletal unloading. The hindlimb elevation (tail suspension) model simulates space flight better than other models because it reproduces the fluid shifts seen in space travel, is reversible, and is well tolerated by the animals with minimal evidence of stress as indicated by continued weight gain and normal levels and circadian rhythms of corticosterone. This is the model we have used for our experiments. Skeletal unloading by the hindlimb elevation method simulates a number of features of space flight in that bone formation, mineralization, and maturation are inhibited, osteoblast number is decreased, serum and skeletal osteocalcin levels fall, the ash content of bone decreases, and bone strength diminishes. We and others have shown that when osteoblasts or osteoprogenitor cells from the bones of the unloaded limbs are cultured in vitro they proliferate and differentiate more slowly, suggesting that skeletal unloading causes a persistent change in cell function which can be assessed in vitro. In contrast to the unweighted bones of the hindlimbs, no significant change in bone mass or bone formation is observed in the humeri, mandible, and cervical vertebrae during hindlimb elevation. The lack of effect of hindlimb elevation on bones like the humeri, mandible, and cervical vertebrae which are not unloaded by this procedure suggests that local factors rather than systemic effects dominate the response of bone to skeletal unloading. We have focussed on the role of IGF- 1 as the local factor mediating the effects of skeletal unloading on bone formation. IGF-I is produced by bone cells and chondrocytes; these cells have receptors for IGF-I, and respond to IGF-I with an increase in proliferation and function (e.g. collagen, and glycosaminoglycan production, respectively). IGF-I production by bone is under hormonal control, principally by GH and PTH, and IGF-I is thought to mediate some if not all of the effects of GH and PTH on bone growth. Thus, systemic changes in hormones such as GH and PTH may still have effects which vary from bone to bone depending on the loading history.
Author

Musculoskeletal System; Bone Mineral Content; Corticosteroids; Hormones

20000020522 Texas A&M Univ., College Station, TX USA

Alterations in pQCT-Derived Bone Geometry and Density Versus Mechanical Structural Properties of the Femoral Neck in Senescent Rats

Bloomfield, S. A., Texas A&M Univ., USA; Hogan, H. A., Texas A&M Univ., USA; Dresser, E. T., Texas A&M Univ., USA; Groves, J. A., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 200-201; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Few data are available on the relationship of bone morphometry and bone mineral density (BMD) to mechanical properties of the femoral neck in senescent rats. Therefore, we studied femoral neck bone excised from young adult and senescent male Fischer rats using peripheral quantitative computed tomography (pQCT), followed by 3-point bending to failure to determine structural mechanical properties.
Author

Bones; Minerals; Density (Mass/Volume); Failure

20000020524 Indiana Univ. Medical Center, Indianapolis, IN USA

The Role of Calcium in the Response of Osteoblasts to Mechanical Stimulation

Duncan, R. L., Indiana Univ. Medical Center, USA; Farach-Carson, M. C., Delaware Univ., USA; Pavalko, F. M., Indiana Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 205-207; In English

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A major biomedical concern in the exploration and development of space is the rapid loss of bone associated with extended periods of spaceflight. Mineral content, bone formation, matrix protein production and total body calcium are all reduced during long-term periods of weightlessness. These effects of weightlessness appears to be due to decreases in the anabolic function of osteoblasts and osteocytes rather than changes in the resorptive activity of osteoclasts. Conversely, subjecting the skeleton to exogenous mechanical loading increases matrix protein synthesis and bone formation rate, a process which also appears mediated

through osteogenic cells. Osteoblasts have been shown to respond to a number of types of mechanical stimulation. However recently we have demonstrated that osteoblasts respond to fluid shear, but not physiologic levels of mechanical strain, with increases in expression of the matrix protein, osteopontin. We have also shown similar responses in other markers for the anabolic response in bone. The expression of the early response gene, c-fos, and the inducible-isoform of the prostaglandin synthetic enzyme, cyclooygenase-2 (COX-2), both increase rapidly in response to fluid shear, but not strain. How osteoblasts and osteocytes perceive mechanical stimuli and convert this stimulus into a biochemical event within the cell is still unknown. However, examination of the cellular events following mechanical stimulation indicate that two of the earliest responses are a rapid increase in intracellular calcium ([Ca(2+)](sub i)) and a reorganization of the actin cytoskeleton. The increase in [Ca(2+)](sub i) is dependent on the presence of extracellular Ca(2+), suggesting the activation of membrane Ca(2+) channel. We have previously characterized a mechanosensitive, cation-selective channel (MSCC) in osteoblast-like clonal cells, which we postulate is important in this early response to mechanical loading. Using an antisense oligodeoxynucleotide strategy, we have tentatively identified this channel as an isoform of the alc subunit of the dihydropyridine-sensitive, voltage sensitive Ca(2+) channel (VSCC). However, a major component in this mechanically induced rise in [Ca(2+)](sub i) is the release of Ca(2+) from intracellular stores. The actin cytoskeleton also rapidly responds to fluid shear with an increase in stress fiber formation and a realignment of the cell parallel to the direction of flow. to ascertain whether these two observations are related and how they effect shear-induced gene expression, we examined the role of Ca(2+) channels and intracellular Ca(2+) release on cytoskeletal reorganization and the resultant increases in the expression and production of c-fos and COX-2 in response to fluid shear.
Derived from text
Calcium; Aerospace Medicine; Biochemistry; Bone Demineralization; Losses; Enzymes; Musculoskeletal System; Weightlessness

20000020525 California Univ., Lab. of Cell Growth, San Francisco, CA USA
Effect of Spaceflight on Extra Cellular Matrix in Osteoblasts Growth Activated Under Microgravity Conditions
Fulford, M. H., California Univ., USA; Gilbertson, V., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 208; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

To determine critical molecular events in osteoblast growth in spaceflight MC3T3-El osteoblasts were used to examine fibronectin (FN) MRNA levels, protein synthesis and FN extracellular matrix accumulation after growth activation in microgravity. FN is known to regulate adhesion, differentiation and function in adherent cells. We paid particular interest to the extracellular matrix since several investigators have reported in vivo and in vitro changes in osteoblast growth and cell shape in flight. to characterize fibronectin's role in these changes, quiescent osteoblasts were sera activated in microgravity with or without a 1-G gravity field. After activation and collection in spaceflight, samples were analyzed on ground. We were able to measure both transcription and translation of extracellular matrix genes in flown 0-g, 1-g conditions and in ground samples.
Author
Bones; Gravitational Fields; Protein Synthesis; Weightlessness

20000020526 NASA Ames Research Center, Moffett Field, CA USA
Effects of Spaceflight on Bone: The Rat as an Animal Model for Human Bone Loss
Halloran, B., California Univ., USA; Weider, T., California Univ., USA; Morey-Holton, E., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 209-210; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The loss of weight bearing during spaceflight results in osteopenia in humans. Decrements in bone mineral reach 3-10% after as little as 75-184 days in space. Loss of bone mineral during flight decreases bone strength and increases fracture risk. The mechanisms responsible for, and the factors contributing to, the changes in bone induced by spaceflight are poorly understood. The rat has been widely used as an animal model for human bone loss during spaceflight. Despite its potential usefulness, the results of bone studies performed in the rat in space have been inconsistent. In some flights bone formation is decreased and cancellous bone volume reduced, while in others no significant changes in bone occur. In June of 1996 Drs. T. Wronski, S. Miller and myself participated in a flight experiment (STS 78) to examine the effects of glucocorticoids on bone during weightlessness. Technically the 17 day flight experiment was flawless. The results, however, were surprising. Cancellous bone volume and osteoblast surface in the proximal tibial metaphysis were the same in flight and ground-based control rats. Normal levels of cancellous bone mass and bone formation were also detected in the lumbar vertebrae and femoral neck of flight rats. Furthermore, periosteal bone formation rate was found to be identical in flight and ground-based control rats. Spaceflight had little or no effect

on bone metabolism! These results prompted us to carefully review the changes in bone observed in, and the flight conditions of previous spaceflight missions.
Author
Bone Demineralization; Bone Mineral Content; Losses; Metabolism; Tibia; Weightlessness

20000020528 Connecticut Univ., Health Center, Farmington, CT USA
Transgenic Markers of Lineage Progression in Mechanically Loaded Bones
Kalajic, I.; Terzic, J.; Mack, K.; Visnjic, D.; Mapta, A.; Gronowicz, G.; Clark, S.; Yeh, J.; Rowe, D.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 214; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Bone formation and remodeling reflects the control of recruitment of osteo-progenitor cells to preosteoblasts, osteoblasts and osteocytes. These same cells also modify the osteoclast pathway. As a first step of appreciating the osteoprogenitor pathway, we have developed transgenic mice expressing a marker gene (CAT or GFP) under control of fragments of the COL1A1 promoter. This promoter appears to have a modular organization such that fragments can be utilized to produce transcriptional activity that is restricted to various connective tissues. As expressed in bone, Col3.6CAT is active in osteoblasts, periosteal cells and osteocytes, but not vascular smooth muscle cells, while the activity of Col2.3CAT is restricted to mature osteoblast. Preliminary data suggests that the pOBCol3.6CAT and pOBCol3.6GFP activity is restricted to the preosteoblast. The advantage of using transgenes to assess osteoblastic activity has been demonstrated in the OIM mouse. This model of human OI has high bone turnover due to defective matrix production as judged by diminished bone volume, low bone formation but high mRNA levels for Col1A1, BSP and OC extracted from OIM bone and high urinary excretion of DPD crosslinks. The ColCAT3.6 transgene was bred into the OIM line and its enzymatic and mRNA level assessed in the three genotypes. There was excellent correlation between the enzyme activity and mRNA levels facilitating easy assessment of osteoblastic activity in intact bone. Relative to the +/+ littermates, the CAT activity was increased 4x in oim/oim and 2x in the oim/+ mice. This contrasts with less than a 2x increase in endogenous mRNA levels of Col1A1, BSP or OC in the oim/oim mice and no significant increase in the oim/+ genotype. The CAT levels are highly reflective of bone formation rates characteristic of growing and mature mice and demonstrate that in growing oim/oim mice maximal bone formation cannot exceed that of normal mice. This may explain why bone fractures are highest in rapidly growing children. The osteoprogenitor lineage cannot meet the concomitant demand of high turnover inherent to OI and the additional demand for longitudinal skeletal growth.
Derived from text
Bone Demineralization; Cardiovascular System; Crosslinking; Defects; Enzyme Activity; Musculoskeletal System; Physical Exercise

20000020529 Yale Univ. School of Medicine, Section of Plastic Surgery, New Haven, CT USA
Common Molecular Events by Hormones and Mechanical Strain Regulate Insulin-Like Growth Factor-1 Expression in Osteoblasts
McCarthy, T. L., Yale Univ. School of Medicine, USA; Chen, Y., Yale Univ. School of Medicine, USA; Ji, C., Yale Univ. School of Medicine, USA; Centrella, M., Yale Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 215-217; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Mechanical load, hormones and growth factors control bone metabolism in vivo and in vitro. Often, small changes in any of these elements can disrupt balanced bone remodeling and skeletal integrity. Because mechanical load helps to maintain bone mass, bone integrity can diminish from disuse or loss of mechanical stimulation in microgravity. Insulin-like growth factor-I (IGF-I) is an important skeletal growth factor. Expression of IGF-I by osteoblasts is increased by activators of protein kinase A (PKA) like parathyroid hormone (PTH) or prostaglandin E(sub 2) (PGE(sub 2)). PGE(sub 2) is made by bone cells in response to certain hormones or mechanical load. We previously showed an important role for IGF-I on collagen matrix synthesis in coupled bone remodeling induced by PTH. In support of this, recent in vivo studies indicate that anabolic effects of PTH or its analogs occur by way of CAMP. Furthermore, a direct correlation between bone mass and serum IGF-I levels was noted in middle aged men with idiopathic osteoporosis, and among inbred strains of mice with significant differences in bone density. Whereas serum IGF-I principally derives from liver, a general decrease in the capability to express IGF-I also may be imposed on skeletal cells. This in effect produces a resistance to normal control mechanisms that occur in response to hormones and mechanical strain. Microgravity is thought to decrease bone formation without significantly altering resorption. Several research groups have predicted that loss of mechanical strain in microgravity may alter the synthesis or activity of local bone growth factors within the skeleton. Consistent with the quick induction of IGF-I by CAMP inducing hormones, work from the Chambers lab identified IGF-I as an early response gene stimulated by short duration compressive strain. Indomethacin, an inhibitor of PGE(sub 2) synthesis, blocked both the induction of IGF-I and the subsequent increase in skeletal collagen synthesis. These results indicate

a key role for both factors in the anabolic response of the skeleton to mechanical loading. We recently defined a molecular link among cAMP, PKA, and IGF-I in hormone activated osteoblasts, predicting that shared mechanisms and downstream effectors may function in both hormone and strain activated IGF-I expression, which then directly influence new collagen synthesis and bone formation.
Author
Molecular Biology; Hormone Metabolisms; Insulin; Osteoporosis; Bones; Loads (Forces); Musculoskeletal System

20000020531 Saint Louis Univ. School of Medicine, Dept. of Pharmacological and Physiological Science, Saint Louis, MO USA
Developmental Regulation of the Collagenase-3 Promoter in Osteoblasts
Partridge, N. C., Saint Louis Univ. School of Medicine, USA; Yang, Y., Saint Louis Univ. School of Medicine, USA; DAlonzo, R. C., Saint Louis Univ. School of Medicine, USA; Winchester, S. K., Saint Louis Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 222-223; In English
Contract(s)/Grant(s): NCC2-884; NAGW-4538; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Previously, we have shown that collagenase-3 MRNA is developmentally expressed in normal, differentiating rat osteoblasts. In vivo, the gene is expressed in a tissue-specific fashion in hypertrophic chondrocytes and osteoblasts and developmentally regulated. Our studies aim at determining the promoter elements and proteins binding to the promoter responsible for tissue and developmental regulation of collagenase-3.
Author
Cells (Biology); Bones; Collagens

20000020537 Mayo Clinic, Dept. of Orthopedics, Rochester, MN USA
Altered Bone Cell Metabolism During Spaceflight
Turner, Russell T., Mayo Clinic, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 236-238; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

My laboratory performs research which is directed toward understanding the cellular and molecular mechanisms by which mechanical usage influences bone mass, architecture and turnover. The goal of this research is to develop countermeasures to prevent disuse-induced bone fractures.
Author
Abnormalities; Bone Demineralization; Cells (Biology); Countermeasures; Research; Losses; Musculoskeletal System; Steady State

20000020543 Baylor Coll. of Medicine, Houston, TX USA
Direct Cloning of Genes Regulated by Mechanical Load
Abdellatif, M., Baylor Coll. of Medicine, USA; Schneider, M. D., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 257; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In an attempt to identify genes that are regulated during pressure overload hypertrophy; we resorted to subtraction hybridization between hearts from sham operated and aortically banded mice. In parallel, we also performed a subtraction between an adult and a neonatal heart, for comparison of pressure overload-induced and normal growth of the heart. This led to the identification of several known (75%) and unknown (25%) genes that were upregulated during both normal and pathological growth of the heart. In general, about 50 % of the known genes belong to one of three functional groups. I- Genes related to transcription, such as: histone H2A.Z, cardiac ankyrin-repeat protein (CARP), Bop2, high mobility group 2, and CDC 10.2- Genes related to translation, such as: quaking protein, p68 RNA helicase, mitochondrial rRNA and tRNA, ribosomal proteins L23a, L7a, S18, and L3, Heterogenous ribonucleoprotein C and F, elongation factor 1-alpha, and RNA helix-destabilizing protein. 3-Genes related to the cytoskeleton and regulation of its structure, such as: thymosin beta-4, Pr22, Cyr6l, desmin, OSF- 2, collagen, Mena+, tropoelastin, and integrin-linked kinase. The remainder of the genes included, approx. 25% repeats of the known genes and approx. 25% of genes belonging to other functional groups, which included the Ras related signaling molecule, RaplB, whose function is still unclear. While all genes tested by Northern analysis, were expressed at higher levels in both neonatal and hypertrophy hearts versus normal adult heart, the CARP was one exception that was upregulated during hypertrophy but had lower levels in the neonatal compared to the adult heart. In general, the subtraction method helped identify several genes, previously unknown for their role in hypertrophy, and some previously unknown even for their presence in the heart, such as the extra-cellular matrix

protein, osteoblast specific factor-2. It also helped identify novel cardiac isoforms, as in the case of the quaking protein. The functional role of these genes in hypertrophy await further investigation.
Author
Cloning (Biology); Genes; Loads (Forces); Heart; Bones

20000020545 Johns Hopkins Medical Institutions, Dept. of Anesthesiology, Baltimore, MD USA
Vascular Reactivity in a Rat Model of Microgravity
Berkowitz, Dan E., Johns Hopkins Medical Institutions, USA; Marucci, Leo, Johns Hopkins Medical Institutions, USA; Asplund, Esther, Johns Hopkins Medical Institutions, USA; Winters, Bradford, Johns Hopkins Medical Institutions, USA; Szumski, Annette, Johns Hopkins Medical Institutions, USA; Nyhan, Daniel, Johns Hopkins Medical Institutions, USA; Shoukas, Artin, Johns Hopkins Medical Institutions, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 259; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Orthostatic intolerance in a major problem following exposure to prolonged bedrest and microgravity. The etiology of attenuated cardiac output (CO) and blood pressure (BP) responses is incompletely understood. Normal or accentuated norepinephrine (NE) response to an orthostatic challenge suggest that the abnormality may be in the end organ (vessels). to test the hypothesis that changes in vascular reactivity may be responsible for hypotension in vitro vessels responses were studied in vessel rings from normal and hind-limb unweighted (HLU) rats. Although the model is well accepted ground based model of microgravity we have verified in chronically instrumented rats (aortic flow probe and arterial line), that redistribution of blood volume/orthostatic stress (70 deg tilt) results in appropriate baroreceptor mediated responses (approx. 10% decrease in CO, approx. 8% increase in BP and approx. 5 - 10% increase in heart rate). Animals were euthanized following 21 days of HLU and 5mm aortic rings (just below the aortic arch), renal (500 mm), carotid and femoral arteries were harvested and placed in vessels chambers containing Krebbs solution. Dose responses to KCL and NE, phenylephrine (PE), U46619 (U4) (thromboxane analogue) were performed in 1/2 log doses. The starting diameter of the vessel rings was similar in all animals. There was a significant rightward shift in the KCl, NE, PE and U4 dose response with a decrease in the maximal response in aortic rings. While renal artery responses to KCL were similar, there were accentuated responses to alpha-1 AR agonists NE and PE in HLU animals. There are significant differences in the EC50 to agonists between carotid and femoral arteries but no differences between control and HLU animals has been demonstrated. Radioligand binding of [125I] HEAT, an alpha-1 AR specific ligand to membranes prepared from rat aorta showed a approx. 60% reduction in receptor number in HLU animals. The change in both receptor dependent and independent contractile activity in aorta suggests that the vascular abnormality observed may be secondary to abnormalities of Ca(2+) mobilization or may represent abnormalities in the contractile machinery involved in excitation contraction coupling. (e.g. vessel atrophy). The reduction in alpha-1 AR receptor number may suggest a mechanism. This is provocative in light of the attenuated sympathetic traffic observed during microgravity/bedrest exposure, and the importance of NE in smooth muscle hypertrophy. The increase in alpha-1 AR specific responses in renal arteries suggests differential regulation of alpha-1 AR's in different vascular beds.
Author
Cardiovascular System; Microgravity; Bed Rest; Blood Pressure; Blood Volume; Cardiac Output; Attitude (Inclination); Physiological Responses

20000020552 Missouri Univ., Dept. of Veterinary Biomedical Sciences, Columbia, MO USA
Mechanisms Underlying Altered Arterial Baroreflex Function in Hindlimb Unloaded Rats
Hasser, E. M., Missouri Univ., USA; Moffitt, J. A., Missouri Univ., USA; Cunningham, J. T., Missouri Univ., USA; Heesch, C. M., Missouri Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 279-281; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Following prolonged periods of exposure to microgravity subjects experience a number of adverse cardiovascular consequences, including orthostatic intolerance. Several possible mechanisms could account for this orthostatic intolerance, including alterations in body fluid volumes, changes in vascular or cardiac responsiveness, and alterations in reflex control of the circulation. Normally, the primary adjustments to an orthostatic challenge require arterial baroreflex mediated increases in peripheral resistance, which are elicited through activation of the sympathetic nervous system to the the vasculature. We therefore hypothesized that hindlimb unloading to simulate exposure to microgravity in rats would result in attenuated baroreflex control of the sympathetic nervous system. A corollary hypothesis was that reflex control of sympathetic nerve activity to the viscera and to skeletal muscle would be impaired in a differential manner. We therefore conducted studies to evaluate arterial baroreflex control of renal (RSNA) and lumbar sympathetic nerve activity (LSNA) following hindlimb unloading in conscious rats.

Additional experiments were carried out to evaluate the afferent and/or central nervous system mechanisms involved in alterations in baroreflex function.
Author
Activity (Biology); Afferent Nervous Systems; Arteries; Body Fluids; Cardiovascular System; Musculoskeletal System; Reflexes

20000020553 Oregon Health Sciences Univ., Div. of Nephrology and Hypertension, Portland, OR USA
Dietary Calcium, Blood Pressure and Vascular Function Following Space Flight
Hatton, D., Oregon Health Sciences Univ., USA; McCarron, D., Oregon Health Sciences Univ., USA; Yue, Q., Oregon Health Sciences Univ., USA; Roullet, C., Oregon Health Sciences Univ., USA; Xue, H., Oregon Health Sciences Univ., USA; Otsuka, K., Oregon Health Sciences Univ., USA; Chapman, J., Oregon Health Sciences Univ., USA; Phanouvong, T., Oregon Health Sciences Univ., USA; Roullet, J., Oregon Health Sciences Univ., USA; Watanabe, M., Oregon Health Sciences Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 282; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Deficits in calcium intake are associated with increased blood pressure, decreased bone mineralization and impaired calcium metabolism. Calcium losses due to exposure to microgravity may result in a similar constellation of outcomes.
Author
Calcium Metabolism; Blood Pressure; Microgravity; Diets; Bone Demineralization

20000020561 California Univ., Coll. of Medicine, Irvine, CA USA
Peripheral Vascular Hyporesponsiveness and Elevated Cerebrovascular Myogenic Tone in Simulated Microgravity: Role of Nitric Oxide-Dependent and -Independent Mechanisms
Purdy, R. E., California Univ., USA; Ding, Y., California Univ., USA; Duckles, S. P., California Univ., USA; Geary, G. G., California Univ., USA; Krause, D. N., California Univ., USA; Vaziri, N. D., California Univ., USA; Sangha, S. D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 300-302; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Microgravity was simulated in the present study using hindlimb unweighting (HU) in rats. We have shown previously that 20 days of HU causes hyporesponsiveness of peripheral arteries to norepinephrine (NE; 1). This was explored further by investigating the role of both nitric oxide dependent and independent mechanisms. Reduced contraction to NE can be due to up-regulation of a vasodilator mechanism, for example, increased activity of either endothelial constitutive nitric oxide synthase (ecNOS) or inducible nitic oxide synthase (iNOS). Such changes were studied in the carotid and femoral arteries. Reduced contraction to NE may also be caused by a decrease in coupling at one or more steps between alpha adrenoceptor stimulation and activation of the contractile apparatus. Coupling was studied in the abdominal aorta in which nitric oxide mechanisms have been shown to have no role in HU-mediated hyporesponsiveness to NE (1). In both real and simulated microgravity, there is an acute cephalad fluid shift and an increase in cerebral perfusion pressure. Adaptation to this increased pressure was studied using isolated middle cerebral arteries from control and HU rats (2). Myogenic tone was increased in HU vessels, consistent with the development of a protective mechanism to prevent overperfusion of the brain vasculature. It is suggested (see Discussion) that peripheral vascular hyporesponsiveness and elevated cerebrovascular myogenic tone interact synergistically to cause postural intolerance.
Author
Cardiovascular System; Microgravity; Stimulation; Cerebrum; Brain Circulation; Adaptation

20000020562 Texas Univ., Rogers Magnetic Resonance Center, Dallas, TX USA
Myocardial Performance and Metabolism in Mice With a Null Mutation in Cytochrome C Oxidase Subunit VIAH
Radford, N. B., Texas Univ., USA; Wan, B., Texas Univ., USA; Szczepaniak, L., Texas Univ., USA; Babcock, E. E., Texas Univ., USA; Richman, A., Texas Univ., USA; Storey, C. S., Texas Univ., USA; Li, J. L., Texas Univ., USA; Li, K., Texas Univ., USA; Moreadith, R. W., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 303-304; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Several lines of evidence suggest that cytochrome c oxidase (COX) subunit VIaH may modulate COX activity, thus exerting regulatory control over oxidative energy production with potential consequences for myocardial mechanical performance. to test this hypothesis in the intact heart, a murine line with a null mutation in COXVIaH was created and an assessment of systolic, diastolic and metabolic performance was made.
Author
Myocardium; Metabolism; Mice; Cytochromes

20000020570 Baylor Coll. of Medicine, Houston, TX USA

Determination of Whether Immune Clearance and Protection From Mucosal Virus Infection are Altered in Ground-Based Mouse Models of Space Flight

Conner, M. E., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 329-330; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We are using anti-orthostatic suspension of mice to determine whether the mucosal immune system is adversely affected in this ground-based model of space flight. Although this model does not simulate all aspects of space flight, it is an accepted ground-based model for studies on a number of parameters including alterations of the immune system. We will utilize rotavirus and the well-characterized immune response to rotavirus in different mouse strains. The effect of space flight or anti-orthostatic suspension on the immune system has been established by examining isolated aspects of the immune system by the use of soluble protein antigens or mitogens or by using viruses or bacteria that establish systemic infections. In all studies, systemic but not mucosal immune responses were evaluated. It is important to evaluate the mucosal response, as -80% of all pathogens invade across mucosal surfaces, so it is the first line of an immunological defense. Many important pathogens, including viruses that cause respiratory and gastrointestinal diseases, produce localized infections at mucosal surfaces.

Author

Immunity; Viruses; Bacteria; Diseases; Physiological Responses; Protection

20000020572 Southern Univ., Dept. of Chemistry, Baton Rouge, LA USA

New Stratetgies for the Detection of E.Coli

Elayan, N., Southern Univ., USA; Xu, Y., Southern Univ., USA; Theegala, C., Southern Univ., USA; Suleiman, A., Southern Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 334; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Conventional methods for the detection and determination of bacteria involve incubation and culturing techniques, which are tedious and time consuming. Methodologies were or are being evaluated utilizing antibodies in conjunction with piezoelectric, electro-chemical, fiberoptic, and membrane-based sensors.

Author

Procedures; Detection; Bacteria; Antibodies

20000020575 NASA Johnson Space Center, Houston, TX USA

Latent Viruses: A Space Travel Hazard??

Ling, P. D., Baylor Coll. of Medicine, USA; Peng, R. S., Baylor Coll. of Medicine, USA; Pierson, D., NASA Johnson Space Center, USA; Lednicky, J., Baylor Coll. of Medicine, USA; Butel, J. S., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 338-339; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A major issue associated with long-duration space flight is the possibility of infectious disease causing an unacceptable medical risk to crew members. Our proposal is designed to gain information that addresses several issues outlined in the Immunology/Infectious disease critical path. The major hypothesis addressed is that space flight causes alterations in the immune system that may allow latent viruses which are endogenous in the human population to reactivate and shed to higher levels than normal which can affect the health of crew members during a long term space-flight mission. We will initially focus our studies on the human herpesviruses and human polyomaviruses which are important pathogens known to establish latent infections in the human population. Both primary infection and reactivation from latent infection with this group of viruses can cause a variety of illnesses that result in morbidity and occasionally mortality of infected individuals. Effective vaccines exist for only one of the eight known human herpesviruses and the vaccine itself can still reactivate from latent infection. Available antivirals are of limited use and are effective against only a few of the human herpesviruses. Although most individuals display little if any clinical consequences from latent infection, events which alter immune function such as immunosuppressive therapy following solid organ transplantation are known to increase the risk of developing complications as a result of latent virus reactivation. This proposal will measure both the frequency and magnitude of viral shedding and genome loads in the blood from humans participating in activities that serve as ground based models of space flight conditions. Our initial goal is to develop sensitive quantitative competitive PCR- based assays (QC-PCR) to detect the herpesvirus Epstein-Barr virus (EBV), and the polyomaviruses SV40, BKV, and JCV. Using these assays we will establish baseline patterns of viral genome load in the blood and viral shedding from normal volunteers in a longitudinal study over I year in length. As a comparison, we will measure patterns of viral genome loads and shedding from individuals who are severely immunosuppressed, in whom herpesvirus reactivation or primary infection with a herpesvirus is known to cause complications. In addition, we will proceed to testing ground based analogs in collaboration with Dr. Duane Pierson (Lyndon B. Johnson Space Center). This will include measuring samples obtained from

individuals living and working in the extreme environment of Antarctica. We expect to detect viral shedding or reactivation from most of the test groups, although the magnitude of shedding or reactivation cannot be predicted. The data accumulated from studies in this proposal should allow us to evaluate whether events that simulate certain aspects of space flight reactivate viral infections severe enough in nature that they may compromise the success of long-term space flight missions. These studies will also provide a foundation to monitor viral reactivation and shedding from crew members participating in actual space flight missions. We will present data showing the establishment of our QC-PCR assay for detection of EBV.
Derived from text
Flight Conditions; Hazards; Health; Infectious Diseases; Immunology; Long Duration Space Flight; Viral Diseases

20000020576 Montana State Univ., Dept. of Microbiology, Bozeman, MT USA
Rapid Assessment of Bacterial Activity in Spacecraft Water Systems
Lisle, John T., Montana State Univ., USA; Pyle, B. H., Montana State Univ., USA; Broadway, S. C., Montana State Univ., USA; McFeters, G. A., Montana State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 340; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Maintaining and monitoring the microbiological quality water supplies on the shuttle and space station is imperitive for crew health. to achieve these goals, rapid methods for the detection of bacteria that may indicate the presence of a health threat or deterioration of water quality are needed. We have used fluorescent antibodies, in conjunction with a suite of intracellular fluorescent stains, to identify the drinking water quality indicator and pathogen Escherichia coli and assess its physiological activity at the level of a single cell. This approach was used to assess the influence of starvation on physiological activity based upon membrane potential (Rh l23), membrane integrity (LIVE/DEAD BacLight kit), respiratory activity (CTC) and intracellular esterase activity (Scan RDI). Each assay was performed in less than one hour. Growth dependent assays were also used to assess substrate responsiveness (DVC), ATP activity (MicroStar) and culturability (R2A agar). This study demonstrates this suite of stains can rapidly assess multiple indices of physiological activity allowing decisions to be made concerning the microbiological quality of spacecraft water in a more timely fashion relative to traditional culture-based methods.
Author
Activity (Biology); Antibodies; Detection; Deterioration; Escherichia; Health; Potable Water; Supplying; Water Quality

20000020577 Rice Univ., Inst. of Biosciences and Bioengineering, Houston, TX USA
Gene Regulation by Mechanical Forces in Vascular Cells
McIntire, Larry V., Rice Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 341-342; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exposure of endothelial cells to shear stress in vitro produces marked alteration in cell morphology, consistent with the proposed in vivo role of shear stress. Moreover, shear stress- mediated regulation of endothelial gene expression has been demonstrated for proteins with key roles in maintaining homeostasis, cell migration, and in cell growth. It has been recently suggested that vascular smooth muscle cells (VSMC) may also be responsive to shear stress. In vivo studies of VSMC growth rates after balloon catheter injury have demonstrated an inverse correlation between growth rates and calculated shear stress forces. In vitro studies have confirmed the in vivo observations and demonstrated that the synthesis of transforming growth factor-(beta)1 (TGF-(beta)1), tissue plasminogen activator (tPA), heme oxygenase- 1, nitric oxide, and prostaglandins increased under shear stress. Consistent with these observations, modeling studies supported the concept that VSCM in the normal vasculature are exposed to significant shear stresses, in the order of 1-10 dyn/ sq cm, due to interstitial fluid flow driven by transmural pressure gradients. On the basis of these findings, the present study was designed to determine whether shear stress also mediates gene expression in VSMC, ultimately leading to the pathologic proliferation of VSMC at sites of disturbed blood flow in the vasculature and perhaps control of vessel wall homeostasis under normal physiological conditions. The human protease activated receptor-1 (PAR-1) gene was chosen because: 1) PAR-1 expression is known to be increased dramatically after experimental injury in animal models, after percutaneous transluminal coronary angioplasty in patients and in human atherosclerosis and 2) the known roles of thrombin on VSMC function and proliferation state can be modulated by regulation of PAR-1 expression.
Author
Arteriosclerosis; Blood Flow; Cardiovascular System; Catheterization; Cell Division; Homeostasis; Shear Stress; Gene Expression

20000020580 NASA Johnson Space Center, Houston, TX USA

Reactivation of Latent Viruses in Space

Pierson, D. L., NASA Johnson Space Center, USA; Mehta, S. K., Enterprise Advisory Services, Inc., USA; Tyring, S. K., Texas Univ., USA; Lugg, D. J., Australian Antarctic Div., Australia; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 348-349; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reactivation of latent viruses is an important health risk for people working and living in physically isolated extreme environments such as Antarctica and space. Preflight quarantine does not significantly reduce the risk associated with latent viruses, however, pharmaceutical countermeasures are available for some viruses. The molecular basis of latency is not fully understood, but physical and psychosocial stresses are known to initiate the reactivation of latent viruses. Presumably, stress induced changes in selected hormones lead to alterations in the cell- mediated immune (CMI) response resulting in increased shedding of latent viruses. Limited access to space makes the use of ground-based analogs essential. The Australian Antarctic stations serve as a good stress model and simulate many aspects of space flight. Closed environmental chambers have been used to simulate space flight since the Skylab missions and have also proven to be a valuable analog of selected aspects of space flight. Author

Viruses; Space Flight; Closed Ecological Systems; Contamination; Health; Physiological Responses

20000020581 Montana State Univ., Dept. of Microbiology, Bozeman, MT USA

Bacterial Biofilms in Microgravity

Pyle, Barry H., Montana State Univ., USA; Broadaway, S. C., Montana State Univ., USA; Johnsrud, C. K., Montana State Univ., USA; Storfa, R. T., Montana State Univ., USA; McFeters, G. A., Montana State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 350; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Human life support systems planned for future long-term space flight missions will require high quality water to minimize the risk of infectious disease and system deterioration. It has been demonstrated that some bacteria may grow more rapidly and can become less susceptible to antimicrobial agents under conditions of microgravity. Also, humans suffer immunosuppression with prolonged space flight. This study was planned to determine the effect of spaceflight and microgravity on biofilm formation by waterborne bacteria and the efficacy of iodine in preventing biofouling. A strain of Burkholderia cepacia, which had been isolated from a NASA Shuttle Orbiter water system, was used to represent oligotrophic bacteria which are likely to be found in water treatment and distribution systems on spacecraft. The results indicated that B. cepacia can form biofilms in a weightless environment. Thus, disinfection and management of spacecraft water systems must take into account the well-known difficulties of controlling attached bacteria.

Author

Bacteria; Microgravity; Microorganisms; Water Treatment; Water Management; Weightlessness; Deterioration; Antiinfectives and Antibacterials

20000020584 NASA Johnson Space Center, Houston, TX USA

Lytic Replication of Epstein-Barr Virus During Space Flight

Stowe, R. P., Texas Univ., USA; Pierson, D. L., NASA Johnson Space Center, USA; Barrett, A. D. T., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 356; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reactivation of latent Epstein-Barr virus (EBV) may be an important threat to crew health during extended space missions. Cellular immunity, which is decreased during and after space flight, is responsible for controlling EBV replication in vivo. In this study, we investigated the effects of short-term space flight on latent EBV reactivation.

Author

Health; Viruses; Hazards

20000020585 Beth Israel Deaconess Medical Center, Lab. for Cell and Molecular Biology, Boston, MA USA

Inhibition of Erythropoiesis in Simulated Microgravity

Sytkowski, A. J., Beth Israel Deaconess Medical Center, USA; Davis, K. L., Beth Israel Deaconess Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 357; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The microgravity conditions experienced in space flight have been show to have adverse effects on hematopoietic cells leading to anemia and reduced immune responsiveness. The cellular basis for these effects is unknown. We have now begun to investigate potential mechanisms responsible for the reduced erythropoiesis encountered in microgravity.
Author
Microgravity; Simulation; Hematopoietic System

20000020587 California Univ., Dept. of Physiology and Biophysics, Irvine, CA USA
Myosin Heavy Chain Gene Expression in Developing Neonatal Skeletal Muscle: Involvement of the Nerve, Gravity, and Thyroid State
Baldwin, K. M., California Univ., USA; Adams, G., California Univ., USA; Haddad, F., California Univ., USA; Zeng, M., California Univ., USA; Qin, A., California Univ., USA; Qin, L., California Univ., USA; McCue, S., California Univ., USA; Bodell, P., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 363-364; In English
Contract(s)/Grant(s): NAG2-942; NIH-NS-33483; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
The myosin heavy chain (MHC) gene family encodes at least six MHC proteins (herein designated as neonatal, embryonic, slow type I (beta), and fast IIa, IIx, and IIb) that are expressed in skeletal muscle in a muscle-specific and developmentally-regulated fashion. At birth, both antigravity (e.g. soleus) and locomotor (e.g., plantaris) skeletal muscles are undifferentiated relative to the adult MHC phenotype such that the neonatal and embryonic MHC isoforms account for 80 - 90% of the MHC pool in a fast locomotor muscle; whereas, the embryonic and slow, type I isoforms account for approx. 90% of the pool in a typical antigravity muscle. The goal of this study was to investigate the role of an intact nerve, gravity and thyroid hormone (T3), as well as certain interactions of these interventions, on MHC gene expression in developing neonatal skeletal muscles of rodents.
Author
Gene Expression; Musculoskeletal System; Thyroid Gland; Gravitation; Antigravity

20000020588 Baylor Coll. of Medicine, Houston, TX USA
Ectopic Expression of Porcine HV-GHRH by a Synthetic Myogenic Vector Elicits Enhanced GH and IGF-1 Secretion and Animal Growth
Akli-Draghia, Ruxandra, Baylor Coll. of Medicine, USA; Deaver, Daniel R., Pennsylvania State Univ., USA; Fiorotto, Marta L., Baylor Coll. of Medicine, USA; Schwartz, Robert J., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 368; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
The tremendous importance of growth hormone stimulating therapies for growth, geriatric associated pathology, or to prevent muscle atrophy in microgravity environments provides a strong incentive to develop myogenic vector systems to drive the expression of peptides like growth hormone releasing hormone (GHRH), strong upstream stimulator of GH.
Author
Geriatrics; Growth; Microgravity; Muscles; Pituitary Hormones

20000020596 Texas A&M Univ., Muscle Biology Lab., College Station, TX USA
Intracellular Calcium Transients in Mouse Soleus Muscle After Hindlimb Unloading and Reloading
Ingalls, C. P., Texas A&M Univ., USA; Warren, G. L., Texas A&M Univ., USA; Armstrong, R. B., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 385; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
Unloading of the antigravity skeletal muscles by space flight or hindlimb suspension initiates a rapid and significant loss of skeletal muscle mass and strength. Furthermore, skeletal muscles atrophied by unloading have an increased susceptibility to contraction-induced muscle injury, so reloading of these muscles may compound existing mass and strength deficits. The mechanisms responsible for the reductions in skeletal muscle mass and strength following unloading and subsequent reloading are not fully understood. The objective of this study was to determine if altered intracellular Ca(2+) handling contributes to the force loss in the soleus muscle after unloading and/or subsequent reloading of mouse hindlimbs.
Author
Calcium; Cells (Biology); Transient Response; Muscles; Antigravity

20000020597 Presbyterian Hospital of Dallas, Dallas, TX USA

Impaired Utilization of Exogenous Substrates by Rat Skeletal Muscle After Hindlimb Suspension

Lujan, B. F.; Bertocci, L. A.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 386-387; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Chronic exposure to the microgravity of spaceflight causes severe skeletal muscle atrophy. Although much is known about the structural consequences of this atrophy, the metabolic effects of this atrophy are much more ambiguous: literature reports of the effects of disuse atrophy on the activities of many of the enzymes involved in exercise metabolism, and the linkage of these changes to indices of the patterns of substrate utilization, are quite contradictory. We speculated that this was due in part to methodological limitations. to address this, we used a combination of H-1 and C-13 nuclear magnetic resonance (NMR) spectroscopy plus a carefully controlled animal model to assess the effect of severe disuse atrophy on the relative utilization of exogenous and endogenous oxidizable substrate in resting versus contracting rat hindlimb muscle.

Author

Utilization; Rats; Physical Exercise; Musculoskeletal System; Metabolism; Enzymes; Limbs (Anatomy)

20000020598 Baylor Coll. of Medicine, Houston, TX USA

Alterations in Neuromuscular Junctions Associated with Muscle Atrophy Induced by Hindlimb Unloading

Mosier, D. R., Baylor Coll. of Medicine, USA; Siklos, L., Baylor Coll. of Medicine, USA; Gooch, C. L., Baylor Coll. of Medicine, USA; Gordon, S., Texas Univ. Health Science Center, USA; Booth, F. W., Texas Univ. Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 388-389; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Many alterations in motor unit structure and function occur with exposure to microgravity during spaceflight, and could lead to impairment of motor performance. In particular, morphologic changes suggestive of denervation and remodeling have been reported at neuromuscular junctions in atrophying muscle, both in space-flown animals and in rodent models of limb immobilization. However, the anatomic extent and physiologic significance of these alterations is unclear. to begin to address these questions, we assayed neuromuscular junctions electrophysiologically using intracellular micropipette recordings and stimulated single-fiber electromyography, in parallel with electron microscopic studies of end-plates, in hindlimb muscles of ICR mice following a 3-week period of unloading by tail suspension.

Author

Neuromuscular Transmission; Atrophy; Unloading; Limbs (Anatomy); Electromyography

20000020602 California Univ., Dept. of Physiological Science, Los Angeles, CA USA

Mechanical and Inflammatory Components of Muscle Injury Following Modified Muscle Loading

Tidball, J. G., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 397-399; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The ability of personnel to function following space flight is limited by debilitating muscle weakness, pain, and inflammation that develop following return to gravitational loading. It has been proposed previously that muscle injury that occurs during muscle loading following periods of reduced loading can result from direct mechanical damage to the muscle or through the actions of inflammatory cells that invade the muscle during the reloading period, but these possibilities have not been tested experimentally. In this investigation, we are examining the contribution of inflammatory cells to muscle injury that occurs following modified muscle use and determining the mechanisms through which inflammatory cells induce muscle injury. We have used the rat hindlimb suspension model followed by muscle reloading by normal weight-bearing activity to examine muscle inflammation in vivo and employed co-cultures of specific inflammatory cell populations with rat muscle cells to perform further studies of the mechanisms of muscle cell injury. The goal of these studies is to characterize the specific inflammatory cell derived mediators of muscle injury during loading following periods of reduced loading, so that therapeutic approaches can be designed to reduce muscle injury following return to gravitational loading after space flight.

Author

Injuries; Muscles; Cells (Biology); Loads (Forces)

20000020603 Brown Univ., Dept. of Pathology, Providence, RI USA

Tissue Engineering Organs for Space Biology Research

Vandenburgh, H. H.; Shansky, J.; DelTatto, M.; Lee, P.; Meir, J.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 400-401; In English

Contract(s)/Grant(s): NAG2-914; NAG2-1205; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long-term manned space flight requires a better understanding of skeletal muscle atrophy resulting from microgravity. Atrophy most likely results from changes at both the systemic level (e.g. decreased circulating growth hormone, increased circulating glucocorticoids) and locally (e.g. decreased myofiber resting tension). Differentiated skeletal myofibers in tissue culture have provided a model system over the last decade for gaining a better understanding of the interactions of exogenous growth factors, endogenous growth factors, and muscle fiber tension in regulating protein turnover rates and muscle cell growth. Tissue engineering these cells into three dimensional bioartificial muscle (BAM) constructs has allowed us to extend their use to Space flight studies for the potential future development of countermeasures.
Author
Tissues (Biology); Musculoskeletal System; Atrophy; Microgravity; Culture Techniques

20000020634 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Comparison of Gamma and Iron Particle Irradiation Induced Remodeling of Extra Cellular Matrix in Murine Liver
Barcellos-Hoff, M. H., California Univ., Lawrence Berkeley Lab., USA; Wang, C., California Univ., Lawrence Berkeley Lab., USA; Ravani, S. A., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 480-482; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Cells in tissues exist in complex microenvironments that mediate phenotype and cell interactions. Microenvironments, which includes the insoluble extracellular matrix (ECM) and soluble cytokines, also modulate cellular response to stimuli, which in turn may modify the microenvironment. Our studies have demonstrated rapid and global remodeling of the microenvironment in irradiated murine mammary gland and have identified characteristics of the High ionizing high energy particles (HZE)-irradiated remodeling that are distinct from those following sparsely ionizing radiation. The hypothesis is that certain effects of HZE particles cause specific modifications of tissue microenvironment as compared to reference gamma-radiation. This in turn is postulated to contribute to the functional and carcinogenic cellular effects of HZE exposure. Identification of HZE-induced changes in the microenvironment will provide insight into how fundamental cellular effects are integrated into multicellular tissue responses. The goal of this study was to evaluate early (1 hr - 7 day) temporal and spatial changes in the composition of the irradiated liver microenvironment as a function of radiation quality and dose or particle fluence. Comparison of liver to mammary gland in terms of microenvironment remodeling may provide insight into mechanisms. Tissue-dependent changes are most likely to be the result of particular cellular response to radiation and may reveal specific mechanisms that underlie tissue sensitivity to radiation of various qualities important to the environment in space.
Author
Gamma Rays; Iron; Irradiation; Radiation Effects; Particle Energy; Exposure; Dosage

20000020636 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Proton Irradiation Alters Expression of FGF-2 In Human Lens Epithelial Cells
Blakely, E. A., California Univ., Lawrence Berkeley Lab., USA; Bjornstad, K. A., California Univ., Lawrence Berkeley Lab., USA; Chang, P. Y., California Univ., Lawrence Berkeley Lab., USA; McNamara, M. P., California Univ., Lawrence Berkeley Lab., USA; Chang, E., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 484; In English
Contract(s)/Grant(s): NASA Order W-18758; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We are investigating a role for proton radiation-induced changes in FGF-2 gene expression as part of the mechanism(s) underlying lens cell injury. Radiation injury to the human lens is associated with the induction of cataract following exposure to protons.
Author
Proton Irradiation; Radiation Injuries; Cells (Biology); Epithelium

20000020637 SRI International Corp., Menlo Park, CA USA
Heavy Ion Induced Genetic Damage in Transgenic Animals
Chang, P. Y., SRI International Corp., USA; Lutze-Mann, L., New South Wales Univ., Australia; Walker, V., New York State Dept. of Health, USA; Torous, D., Litron Labs., USA; Winegar, R. A., SRI International Corp., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 485-487; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The radiation environment in space is complex in that it contains a variety of densely ionizing particles that are capable of producing DNA damage. The long-term radiation risks are dependent on the types of molecular injuries and the subsequent processing of these lesions. We are using transgenic mice containing lacz reporter genes in every cell to evaluate the tissuespecific responses at the molecular level after heavy particle radiation. The lacz target gene has also been introduced into p53 knockout

transgenic mice to obtain animals that are either hemizygous (p53+/-lacZ) or nullizygous (p53-/-lacZ) with regard to their p53 status. The use of these animals allows us to evaluate the influence of p53 genetic background on radiation-induced genetic damage. We evaluated the induced lacZ mutation frequency (MF) in three tissues: liver, brain and spleen. Using the same animals, we also measured hprt in splenic lymphocytes and cytogenetic damage in erythrocytes.
Author
Heavy Ions; Genetics; Damage; Animals; Radiation Damage

20000020639 NASA Johnson Space Center, Houston, TX USA
NSBRI Radiation Effects: Carcinogenesis in Sprague-Dawley Rats Irradiated with Iron Ions, Protons, or Photons
Dicello, J. F., Johns Hopkins Univ., USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Gridley, D. S., Loma Linda Univ., USA; Howard, S. P., Wisconsin Univ., USA; Novak, G. R., Johns Hopkins Univ., USA; Ricart-Arbona, R., Johns Hopkins Univ., USA; Strandberg, J. D., Johns Hopkins Univ., USA; Vazquez, M. E., Brookhaven National Lab., USA; Williams, J. R., Johns Hopkins Univ., USA; Zhang, Y., Johns Hopkins Univ., USA; Zhou, H., Johns Hopkins Univ., USA; Huso, D. L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 490-492; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our ability to confidently develop appropriate countermeasures for radiations in space in terms of shielding and design of a spacecraft, the mission scenario, or chemoprevention is severely limited by the uncertainties in both the risk itself and the change in that risk with intervention. Despite the fact that the risk of carcinogenesis from exposures of personnel to radiations on long-term missions is considered one of the worst hazards in space, only a limited amount of in-vivo data exist for tumor induction from exposures to protons or energetic heavy ions (HZEs) at lower doses. The most extensive work remains the landmark study. for tumor development in the harderian gland of the mouse. The objective of this study is to characterize the level of risk for tumor induction in another relevant animal model. Subsequent experiments are designed to test the hypothesis that the level of risk can be reduced by pharmaceutical intervention in the promoting and progressing stages of the disease rather than in the initiating stage. The work presented here results from a cooperative effort on the part of investigators from two projects of the Radiation-Effects Team of the National Space Biomedical Research Institute (NSBRI). The collaborating projects are the Core Project which is investigating the risk of carcinogenesis in Sprague-Dawley rats and the Chemoprevention Project which is investigating the ability of Tamoxifen to reduce the number of malignant tumors in the irradiated animals. Research at the cellular and subcellular levels is being conducted in two other projects of the Radiation-Effects Team, Cytogenetics with J. R. Williams as Principal Investigator and Mutations from Repeated DNA Sequences. Results for these other projects also are being presented at this Workshop.
Author
Radiation Effects; Carcinogens; Rats; Iron; Irradiation; Ionizing Radiation; Photons; Protons; Countermeasures

20000020652 Johns Hopkins Univ., Oncology Center, Baltimore, MD USA
Cytogenetic Damage from Photons, Fe-Ions and Protons: Modulation by Dose-Rate and Cell Type
Williams, J. R., Johns Hopkins Univ., USA; Houming, Z., Johns Hopkins Univ., USA; Dicello, F. E., Johns Hopkins Univ., USA; Zhang, Y., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 528; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We examined the induction of chromosome damage in multiple cell types irradiated with graded acutely-delivered doses of photons, Fe-ions and protons. Further we have compared the effects of photons delivered at -50 Gy/hr to effects when irradiation is delivered at 0.25 Gy/hr.
Author
Cytogenesis; Damage; Photons; Iron; Metal Ions; Protons

20000020656 California Univ., Section of Neurobiology, Physiology and Behavior, Davis, CA USA
Gender Differences in the Responses of Rhesus Monkeys to 2G
Barger, L. K., California Univ., USA; Fuller, C. A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 538-540; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Organisms exposed to alterations in the gravitational environment demonstrate several physiological and behavioral responses. Among the affected physiological systems is the Circadian Timing System (CTS). The CTS coordinates an animal's physiology and behavior, ensuring that the body is in the proper state for anticipated activities. We know from previous research that exposure to spaceflight affects the circadian rhythms of organisms ranging from unicells to primates. Different rhythms do not respond in the same fashion, producing an internal desynchronization between the various circadian rhythms. Desynchronization between internal rhythms may be linked to reduced capabilities in the performance of simple tasks and to psychological abnormalities. There is a preponderance of women among those treated for psychological disorders, including those

linked to circadian dysfunction. This has been attributed to various physiological, psychological and sociological differences, but no innate underlying cause has yet been proved. Moreover, women now form a substantial part of the space research program and are frequent space travelers. Therefore, it is important to characterize the responses of females to an altered force environment. We undertook this study to elucidate the response of multiple physiological and behavioral circadian rhythms of a non-human primate to an altered force environment. Male and female responses to chronic centrifugation were characterized and examined for gender differences. Additionally, when studying the circadian rhythms of females, menstrual cyclicity may play a major role. It has been shown that reproductive cyclicity has a significant influence on the regulation of circadian rhythms in rodents. An extensive study had not been undertaken using a menstrual animal such as the Rhesus monkey (Macaca mulatta) as a biomedical model. It was important to define the cycling status of our female subjects and examine the effects of menstrual cyclicity on physiological and behavioral circadian rhythms in female Rhesus monkeys before beginning the chronic centrifugation study.
Author

Abnormalities; Circadian Rhythms; Exposure; Monkeys; Physiological Responses

20000020671 NASA Ames Research Center, Moffett Field, CA USA

Biona-C Cell Culture pH Monitoring System

Friedericks, C., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 576; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Sensors 2000! is developing a system to demonstrate the ability to perform accurate, real-time measurements of pH and CO2 in a cell culture media in Space. The BIONA-C Cell Culture pH Monitoring System consists of S2K! developed ion selective sensors and control electronics integrated with the fluidics of a cell culture system. The integrated system comprises a "rail" in the Cell Culture Module (CCM) of WRAIR (Space Biosciences of Walter Read Army Institute of Research). The CCM is a Space Shuttle mid-deck locker experiment payload. The BIONA-C is displayed along with associated graphics and text explanations. The presentation will stimulate interest in development of sensor technology for real-time cell culture measurements. The transfer of this technology to other applications will also be of interest. Additional information is contained in the original document.
Author

Cells (Biology); Culture Techniques; pH; Sensors; Fabrication; Carbon Dioxide

20000020676 NASA Ames Research Center, Moffett Field, CA USA

NASA Ames Research Center R and D Services Directorate Biomedical Systems Development

Pollitt, J., NASA Ames Research Center, USA; Flynn, K., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 581; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Ames Research Center R&D Services Directorate teams with NASA, other government agencies and/or industry investigators for the development, design, fabrication, manufacturing and qualification testing of space-flight and ground-based experiment hardware for biomedical and general aerospace applications. In recent years, biomedical research hardware and software has been developed to support space-flight and ground-based experiment needs including the E 132 Biotelemetry system for the Research Animal Holding Facility (RAHF), E 100 Neurolab neuro-vestibular investigation systems, the Autogenic Feedback Systems, and the Standard Interface Glove Box (SIGB) experiment workstation module. Centrifuges, motion simulators, habitat design, environmental control systems, and other unique experiment modules and fixtures have also been developed. A discussion of engineered systems and capabilities will be provided to promote understanding of possibilities for future system designs in biomedical applications. In addition, an overview of existing engineered products will be shown. Examples of hardware and literature that demonstrate the organization's capabilities will be displayed. The Ames Research Center R&D Services Directorate is available to support the development of new hardware and software systems or adaptation of existing systems to meet the needs of academic, commercial/industrial, and government research requirements. The Ames R&D Services Directorate can provide specialized support for: System concept definition and feasibility Mathematical modeling and simulation of system performance Prototype hardware development Hardware and software design Data acquisition systems Graphical user interface development Motion control design Hardware fabrication and high-fidelity machining Composite materials development and application design Electronic/electrical system design and fabrication System performance verification testing and qualification.
Author

Biotelemetry; Design Analysis; Fabrication; Performance Tests; Data Acquisition; Feasibility Analysis; Hardware; Motion Simulators; Workstations

20000020686 Nebraska Univ., Dept. of Physiology and Biophysics, Omaha, NE USA

Head-Out Water Immersion in the Primate as a Model for the Cardiovascular/Renal Effects of Micron-G

Cornish, Kurtis G., Nebraska Univ., USA; Hughes, Kathryn, Nebraska Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 263-266; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objectives of this research were: 1) Develop a non-human primate model that simulates the cardiovascular deconditioning that is exhibited by the astronauts; 2) Determine how in the baroreflex control of blood pressure is altered during and after 72 hrs of simulated microgravity; 3) Determine if there is an alteration in the control of blood volume during simulated microgravity; 4) Investigate possible counter measures that could be used in order to prevent the orthostatic hypotension that has been observed in the astronauts.

Author

Water Immersion; Hypotension; Cardiovascular System; Blood Pressure; Models

20000020763 Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD USA

SERDP: Advanced Biotelemetry for Resource Management on Military Lands (CS-759) ***Final Report***

Seegar, William S.; Fuller, Mark R.; Jan. 1999; 123p; In English; Prepared in cooperation with the Department of Interior, Raptor Research and Technical Assistance Center, Boise, ID and Center for Conservation Research and Technology, Univ. of Maryland Baltimore County, MD.

Report No.(s): AD-A371079; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The process of natural resource management and planning begins with a thorough inventory and description of a natural system's flora and fauna. This information is critical for the development and implementation of effective integrated natural resource management plans. Such plans, in turn, allow land managers, such as the U.S. Department of Defense, to maintain biodiversity, conserve natural resources, and comply with applicable environmental laws and regulations in concert with mission requirements. Advanced biotelemetry capabilities that incorporate the latest innovations in microelectronics, GIS, remote sensing, and computer modeling offer great promise in helping to define and characterize human effects on species and ecological communities and to identify strategies to ensure their sustain ability in the face of expanding human enterprise.

DTIC

Bioinstrumentation; Land Use; Computerized Simulation; Resources Management; Radio Telemetry; Biological Diversity; Biotelemetry; Remote Sensing; Earth Resources

20000020997 California Inst. of Tech., Pasadena, CA USA

Enzyme catalysts for a biotechnology-based chemical industry ***Final Report, 1993 Sep. - 28 Sep. 1998***

Arnold, F. H.; Nov. 16, 1998; 7p; In English

Report No.(s): DE99-002094; DOE/CH/10578-T5; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

Enzymes have enormous potential for reducing energy requirements and environmental problems in the chemicals and pharmaceutical industries. The explosion of tools that has come out of molecular biology during the last 20 years has made it possible to evolve enzymes for features never required in nature. Scientists can speed up the rate and channel the direction of evolution by controlling mutagenesis and the accompanying selection pressures. Darwinian evolution carried out in the test tube offers a unique opportunity for biotechnology: the ability to tailor enzymes for optimal performance in a wide range of applications. Thus it is possible, for example, to evolve enzymes that carry out reactions on nonnatural substrates or even to carry out reactions for which there is no counterpart in nature. Due to the vast size of the potential sequence space, however, explorations by directed evolution must be guided by sound principles and workable strategies. During the course of this group, this laboratory has continued to make significant progress in the evolution of industrial enzymes as well as in developing general methods for in vitro evolution.

NTIS

Catalysts; Enzymes; Biotechnology; Molecular Biology

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 Science. For the effects of space on animals and plants see 51 Life Sciences.

20000017934 Navy Experimental Diving Unit, Panama City, FL USA
Use of Emergency Evacuation Hyperbaric Stretcher (EEHS) in Submarine Escape and Rescue
Latson, Gary W.; Flynn, Edward T., Jr.; Oct. 1999; 50p; In English
Contract(s)/Grant(s): Proj-S0099
Report No.(s): AD-A371262; NEDU-TR-4-99; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. Navy identified a need for portable and collapsible one-man hyperbaric chambers, called Emergency Evacuation Hyperbaric Stretchers (EEHS), which could be used as a means of transporting submarine rescues suffering from Decompression Sickness (DCS) or Arterial Gas Embolism (AGE) to a recompression chamber for treatment. This report discusses the possible uses of such a system in the U.S. Navy Submarine Rescue Mission. Medical indications and contraindications for use of the system are reviewed. Characteristics of the currently favored system are described. Triage algorithms and treatment guidelines are presented for submarine escape, submarine rescue, and evacuation using the EEHS. The EEHS represents a significant advance in acute management of distressed submarine casualties, but many logistical issues will require careful consideration and planning.
DTIC
Decompression Sickness; Hyperbaric Chambers; Emergencies; Evacuating (Transportation); Rescue Operations; Aeroembolism

20000017950 Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada
Effects of Dehydration, Hypohydration, and Hyperhydration on Tolerance During Uncompensable Heat Stress
McLellan, Tom M., Defence and Civil Inst. of Environmental Medicine, Canada; Cheung, Stephen S., Defence and Civil Inst. of Environmental Medicine, Canada; Latzka, William A., Army Research Inst. of Environmental Medicine, USA; Sawka, Mike N., Army Research Inst. of Environmental Medicine, USA; Pandolf, Kent B., Army Research Inst. of Environmental Medicine, USA; Millard, Claire E., Defence Research Agency, UK; Withey, W. Reg, Defence Research Agency, UK; Canadian Journal of Appl. Physiology; [1999]; Volume 24, No. 4, pp. 349-361; In English
Report No.(s): AD-A369081; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The present study examined the effects of dehydration from prior exercise on subsequent exercise tolerance time (TT) that involved wearing nuclear biological, and chemical (NBC) protective clothing. It was hypothesised that TT would be reduced in the dehydrated state. Ten men undertook continuous treadmill walking at 4.8 km/h at 35Cand 50% relative humidity, wearing NBC clothing while euhydrated (EU) or dehydrated (D) by 2.l3% of body weight. Hydration status had no impact on thermoregulatory or cardiovascular responses during exercise. Also rectal temperature at exhaustion did not differ between EU (38.52 +/- 0.39 C) and D (38.43 +/- 0.45 C). Exercise TT during this uncompensable heat stress was reduced significantly for D (47.7 +/- 15.3 min) compared with EU (59.0 +/- 13.6 min). It was concluded that prior exercise leading to levels of dehydration to 2.3% of body weight, together with subsequent fluid restriction during exposure to uncompensable hear stress, impaired TT while wearing the NBC protective clothing. The integration of these findings together with other comparable studies that have examined the influence of hypo- and hyperhydration on TT while wearing NBC protective clothing revealed that hydration status has less effect on TT as the severity of uncompensable heat stress increases,
Author
Dehydration; Heat Tolerance; Human Beings; Physical Exercise; Physiological Responses; Protective Clothing; Thermoregulation; Water Loss; Body Temperature

20000017993 Old Dominion Univ., Research Foundation, Norfolk, VA USA
Commercialization and Industrial Development for the Fetal Hear Rate Monitor ***Final Report, Period ending 31 Aug. 1999***
Zahorian, Stephen, Old Dominion Univ., USA; January 2000; 16p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG1-2123
Report No.(s): ODURF-191331; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary objectives for this task were to continue the development and testing of the NASA/ODU passive acoustic fetal heart rate monitor, with the goal of transferring the technology to the commercial sector. Areas of work included: 1. to assist in the development of a new hardware front end electronics box for the fetal heart rate monitor, so as to reduce the size of the

electronics box, and also to provide for a ”low-frequency” and ”high-frequency” mode of operation. to make necessary changes in the operating software to support the two modes of operation. 2. to provide an option for a strip chart recording for the system, so that medical personnel could more easily make comparisons with ultra sound strip chart recordings. and 3. to help with continued testing of the system.
Author
Product Development; Fabrication; Performance Tests; Monitors; Measuring Instruments; Heart Rate

20000020486 NASA Lewis Research Center, Cleveland, OH USA
Quantifying Biomechanical Characteristics of Jumping Exercises in 1G and in Simulated and True Microgravity
Davis, B. L., Cleveland Clinic Foundation, USA; DAndrea, S. E., Barry Univ., USA; Perusek, G., NASA Lewis Research Center, USA; Orlando, T., Cleveland Clinic Foundation, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 365-367; In English; See also 20000020485
Contract(s)/Grant(s): NAG5-4086; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exercise in microgravity is one of the most promising countermeasures to the dual problems of space flight-induced bone loss and muscle atrophy. Although exercise in microgravity has been studied extensively from a metabolic standpoint, little research has focused on the efficacy of different forms of exercise for maintaining musculoskeletal integrity. Exercise protocols have not been effective in preventing muscle atrophy and bone loss during space flight, especially in the lower extremities. In 1-G, however, animal experiments have clearly indicated that: (1) certain bone strains and strain rates do stimulate bone deposition, and (2) repetitive loading of the lower extremity can increase osteonal bone formation even as proximally as the vertebral column. Such studies have also indicated that a relatively small number of appropriate loading cycles may lead to bone deposition. This suggests that an optimal exercise regimen might be able to maintain bone and muscle integrity during space flight. Since there is evidence that the bones and muscles of the lower limbs are particularly affected by space flight, the present study addressed two major aims: (1) quantify externally applied impact loads and rates of loading under the feet during tethered jumping exercises, and (2) determine the amount of eccentric and concentric whole-muscle activity during these jumping exercises in true and in simulated zero-gravity.
Author
Activity (Biology); Biodynamics; Bone Demineralization; Countermeasures; Gravitation; Impact Loads; Muscular Function; Physical Exercise

20000020498 Texas Univ., Baromedical Lab., Houston, TX USA
Role of Inflammatory Reponse in Experimental Decompression Sickness
Butler, B. D., Texas Univ., USA; Little, T., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 116-119; In English
Contract(s)/Grant(s): NAG9-215; NAGW-4479; NAG9-6176; NAG9-1040; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Decompression to altitude can result in gas bubble formation both in tissues and in the systemic veins. The venous gas emboli (VGE) are often monitored during decompression exposures to assess risk for decompression sickness (DCS). Astronauts are at risk for DCS during extravehicular activities (EVA), where decompression occurs from the Space Shuttle or Space Station atmospheric pressure of 14.7 pounds per square inch (PSI) to that of the space suit pressure of 4.3 PSI. DCS symptoms include diffuse pain, especially around joints, inflammation and edema. Pathophysiological effects include interstitial inflammatory responses and recurring injury to the vascular endothelium. Such responses can result in vasoconstriction and associated hemodynamic changes.The granulocyte cell activation and chemotaxin release results in the formation of vasoactive and microvascular permeability altering mediators, especially from the lungs which are the principal target organ for the venous bubbles, and from activated cells (neutrophils, platelets, macrophages). Such mediators include free arachidonic acid and the byproducts of its metabolism via the cyclooxygenase and lipoxygenase pathways (see figure). The cyclooxygenase pathway results in formation of prostacyclin and other prostaglandins and thromboxanes that cause vasoconstriction, bronchoconstriction and platelet aggregation. Leukotrienes produced by the alternate pathway cause pulmonary and bronchial smooth muscle contraction and edema. Substances directly affecting vascular tone such as nitric oxide may also play a role in the respose to DCS. We are studying the role and consequent effects of the release inflammatory bioactive mediators as a result of DCS and VGE. More recent efforts are focused on identifying the effects of the body's circadian rhythm on these physiological consequences to decompression stress. al
Author
Decompression Sickness; Aeroembolism; Bronchi; Cardiovascular System; Extravehicular Activity; Leukocytes; Pressure Reduction; Vasoconstriction

20000020499 Pennsylvania Univ. Medical Center, Environmental Biomedical Research Data Center, Philadelphia, PA USA

Quantitative Prediction of Pulmonary Oxygen Poisoning Stress in Human Exposures to Changing Degrees of Inspiratory Hyperoxia

Lambertsen, C. J., Pennsylvania Univ. Medical Center, USA; Clark, J. M., Pennsylvania Univ. Medical Center, USA; Hopkin, E., Pennsylvania Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 120-123; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Redevelopment and improved validity have been accomplished, for graphic and mathematical modeling of rates and magnitudes of pulmonary mechanical function decrements, in varied degrees and duration of hyperoxic exposures. The original (1968) IFEM predictive model of Unit Pulmonary Toxic (O2) Dose and Cumulative Pulmonary Toxic Dose, in use over 30 years, was derived with the then limited usable data of two experiment series at .83 and .98 ATA 02 and one series at 2.0 ATA. The present redevelopment program has included extensive additional data for series of prolonged exposures at 1, 1.5, 2.0, 2.5 and 3.0 ATA O2, involving use of 101 subjects overall.

Author

Quantitative Analysis; Pulmonary Functions; Oxygen; Toxicity; Human Behavior; Hyperoxia

20000020506 NASA Johnson Space Center, Houston, TX USA

Effects of Promethazine on Performance During Simulated Shuttle Landings

Harm, D. L., NASA Johnson Space Center, USA; Putcha, L., NASA Johnson Space Center, USA; Sekula, B. K., Enterprise Advisory Services, Inc., USA; Berens, K. L., Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 148-149; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Promethazine (PMZ) is the antimotion sickness drug of choice in the U.S. Space Shuttle program; however, virtually nothing is known about the bioavailability and performance effects of this drug in the microgravity environment. PMZ has detrimental side effects on human performance on Earth that could affect Shuttle operations. In a recent ground-based study we examined: 1) the effects of promethazine (PMZ) on Shuttle landing performance using the portable inflight landing operations trainer (PILOT), and 2) saliva and urine samples to determine the pharmacokinetics of PMZ. The PILOT performance data is presented here.

Author

Training Devices; Promethazine; Pilot Performance; Motion Sickness Drugs; Microgravity; Human Performance; Antiemetics and Antinauseants

20000020519 NASA Ames Research Center, Moffett Field, CA USA

Bone Density and High Salt Diets in a Space Flight Model

Arnaud, S. B., NASA Ames Research Center, USA; Navidi, M., Lockheed Martin Engineering and Science Services, USA; Liang, M. T. C., Bowling Green State Univ., USA; Wolinsky, I., Houston Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 192-193; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

High salt diets accelerate bone loss with aging in patients with postmenopausal osteoporosis except when calcium supplementation is provided. We have observed that the decrease in mineral content of growing femurs in juvenile rats, exposed to a space flight model which unloads the hind limbs , is substantially less in animals fed excess salt. to determine whether excess dietary salt has the same effect on the skeleton of the mature animal whose response to unloading is increased resorption and bone loss rather than impaired growth, we carried out a metabolic study in mature rats with hindlimbs unloaded by tailsuspension.

Author

Bone Demineralization; Osteoporosis; Musculoskeletal System; Minerals; Calcium

20000020523 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

Compact, High Precision, Multiple Projection DEXA Scanner for Measurement of Bone and Muscle Loss During Prolonged Spaceflight

Charles, H. K., Jr., Johns Hopkins Univ., USA; Beck, T. J., Johns Hopkins Medical Institutions, USA; Feldmesser, H. S., Johns Hopkins Univ., USA; Magee, T. C., Johns Hopkins Univ., USA; Pisacane, V. L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 202-204; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The purpose of the Dual Energy X-ray Absorptiometry (DEXA) project is to design, build, and test an advanced X-ray absorptiometry scanner capable of being used to monitor the deleterious effects of weightlessness on the human musculoskeletal system during prolonged spaceflight. The instrument is based on the principles of dual energy X-ray absorptiometry and is designed, not only to measure bone mineral density and volume and to decompose soft tissue into measurements of fat and lean

mass but also, to use those measurements to derive structural properties (cross sections, moments of inertia) permitting an assessment of the biomechanical upon consequences of microgravity on bone and/or muscle mass and the potential risk upon returning to planetary gravity levels. Multiple projection technology, coupled with axial translation, will be employed to provide geometric properties in three dimensions suitable for a three-dimensional structural analysis of the scanned region. The structural analysis will then be combined with bone models and projected loading scenarios to determine risk of fracture. The instrument will employ advanced fabrication techniques to minimize volume and mass (100 kg current target with a long-term goal of 60 kg) of the scanner as appropriate for the space environment, while maintaining the required mechanical stability for high-precision measurement. The unit will have the precision required to detect changes in bone mass and geometry as small as 1% and changes in muscle mass as small as 5%.
Author
Design Analysis; Fabrication; Performance Tests; X Rays; Absorption Spectroscopy; Weightlessness; Structural Analysis; Musculoskeletal System; Bone Demineralization; Scanners

20000020527 Mississippi Univ. Medical Center, Jackson, MS USA
Effects of Spaceflight on the Attachment of Muscle to the Tibia, Fibula and Calcaneus
Johnson, R. B., Mississippi Univ. Medical Center, USA; Tsao, A. K., Mississippi Univ. Medical Center, USA; St.John, K. R., Mississippi Univ. Medical Center, USA; Betcher, R. A., Mississippi Univ. Medical Center, USA; Tucci, M. A., Mississippi Univ. Medical Center, USA; Parsell, D. E., Mississippi Univ. Medical Center, USA; Dai, X., Mississippi Univ. Medical Center, USA; Zardiackas, L. D., Mississippi Univ. Medical Center, USA; Benghuzzi, H. A., Mississippi Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 211-213; In English
Contract(s)/Grant(s): NCC2-863; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Microgravity significantly reduces transmission of ground-reaction forces to bones, promoting atrophy. There is little information available concerning the effects of microgravity on bones at sites where anti-gravity muscles are attached (tendon-bone junctions). This study evaluates the effects of microgravity on the origin and insertion sites of anti-gravity muscles on the rat tibia, fibula and calcaneus. Changes in the strength of those tendon-bone junctions could predispose the animal to injury following spaceflight.
Author
Tibia; Tendons; Muscles; Gravitation; Bones; Atrophy

20000020530 Baylor Coll. of Medicine, Dept. of Cell Biology, Houston, TX USA
Novel Receptor-Based Countermeasures to Microgravity-Induced Bone Loss
OMalley, B. W., Baylor Coll. of Medicine, USA; Smith, C. L., Baylor Coll. of Medicine, USA; Weigel, N. L., Baylor Coll. of Medicine, USA; Brown, E. M., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 218-221; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Manned space flight has opened new frontiers for human exploration, but humans in a microgravity environment for an extended time experience numerous physiological changes, including bone loss. Weight-bearing exercise contributes significantly to bone health, and it is likely reduced mechanical load is a major cause of microgravity-induced osteopenia. However, changes in the levels of systemic factors regulating bone formation and resorption [growth factors, calcium, steroids and 1,25-dihydroxyvitamin D (1,25-D)] occur in humans and animals in microgravity, and it is likely that these alterations also negatively influence bone. The biological actions of these hormones are mediated by their receptors [estrogen receptor (ER), vitamin D receptor (VDR) and Ca(2+)0 -sensing receptor (CaR)], which play key roles in the normal 0 bone turnover that is necessary for skeletal health. These receptors control: (1) differentiation of osteoblast (OB) and osteoclast (OC) precursors, (2) functions of mature OBs and OCs and/or (3) other cells within the bone and bone marrow microenvironment controlling (1) and (2) (e.g. stromal cells and monocytes). Thus, we hypothesize that appropriate use of novel ER-, VDR- and CaR-based therapeutics will mitigate the reduced bone formation and increased bone resorption that contribute to microgravity-induced bone loss. Indeed, synergistic interactions among these receptors may enhance the actions of any one used alone.
Author
Countermeasures; Microgravity; Bone Demineralization; Bone Marrow; Musculoskeletal System

20000020532 Pennsylvania State Univ., Center for Locomotion Studies, University Park, PA USA

Exercise Countermeasures for Bone Loss During Space Flight: A Method for the Study of Ground Reaction Forces and their Implications for Bone Strain

Peterman, M., Pennsylvania State Univ., USA; McCrory, J. L., Pennsylvania State Univ., USA; Sharkey, N. A., Pennsylvania State Univ., USA; Piazza, S., Pennsylvania State Univ., USA; Cavanagh, P. R., Pennsylvania State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 224-227; In English

Contract(s)/Grant(s): NAGW-4421; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Effective countermeasures to prevent loss of bone mineral during long duration space flight remain elusive. Despite an exercise program on MIR flights, the data from LeBlanc et al. (1996) indicated that there was still a mean rate of loss of bone mineral density in the proximal femur of 1.58% per month (n=18, flight duration 4 - 14.4 months). The specific mechanisms regulating bone mass are not known, but most investigators agree that bone maintenance is largely dependent upon mechanical demand and the resultant local bone strains. A plausible hypothesis is that bone loss during space flight, such as that reported by LeBlanc et al. (1996), may result from failure to effectively load the skeleton in order to generate localized bone strains of sufficient magnitude to prevent disuse osteoporosis. A variety of methods have been proposed to simulate locomotor exercise in reduced gravity. In such simulations, and in an actual microgravity environment, a gravity replacement load (GRL) must always be added to return the exercising subject to the support surface and the resulting skeletal load is critically dependent upon the magnitude of the GRL. to our knowledge, GRLs during orbital flight have only been measured once (on STS 81) and it is likely that most or all prior treadmill exercise in space has used GRLs that were less than one body weight. McCrory (1997) has shown that subjects walking and running in simulated zero-G can tolerate GRLs of 1 if an appropriate harness is used. Several investigators have attempted to measure in vivo strains and forces in the bones of humans, but have faced ethical and technical limitations. The anteromedial aspect of the tibial midshaft has been a common site for the placement of strain gauges; one reason to measure strains in the anterior tibia is that this region is surgically accessible. Aamodt et al. (1997) were able to measure strains on the lateral surface of the proximal femur only because their experimental subjects were already scheduled for hip surgery. Lu et al. (1997) used an instrumented massive proximal femoral prosthesis along with electromyographic measurements to demonstrate that femoral forces depend on muscular activity. These analyses of in vivo bone mechanics are valuable. The invasive nature of the procedures involved, however, limits both the number of subjects and the number of strain gauge locations. Further, the results of these studies may be confounded by the inclusion of subjects with pathological conditions. Gross et al. (1992) measured strain at three locations on the equine third metacarpal and used those data to construct a computer model of the internal strain environment of the bone. An analogous placement of multiple gauges in living humans would be difficult and potentially hazardous because of the depth of soft tissue overlying the tibia and femur.

Derived from text

Countermeasures; Bone Demineralization; Space Flight; Computerized Simulation; Femur; Gravitation; Physical Exercise

20000020533 State Univ. of New York, Musculo-Skeletal Research Lab., Stony Brook, NY USA

Expression of Novel Gene Products Upregulated by Disuse is Normalized by an Osteogenic Mechanical Stimulus: Evidence for the Molecular Basis of a Low Level Biomechanical Countermeasure for Osteoporosis?

Rubin, C., State Univ. of New York, USA; Zhi, J., State Univ. of New York, USA; Xu, G., State Univ. of New York, USA; Cute, M., State Univ. of New York, USA; McLeod, K., State Univ. of New York, USA; Hadjiargyrou, M., State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 228-231; In English

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The National Research Council's report entitled: A Strategy for Space Biology and Medical Science, highlighted several areas of fundamental scientific investigation which must be addressed to make long-term space exploration not only feasible, but safe. This "Goldberg Strategy," as well as several subsequent reports published by the NRC's Space Studies Board (e.g., Assessment of Programs in Space Biology and Medicine, Smith et. al., 1991), suggests that the principal hurdle to man's extended presence in space is the osteopenia which parallels reduced gravity. Ironically, the most significant risk to the skeleton may only be realized on return to normal gravitational fields, and full recovery of bone mass may never occur. Effective counter-measures to this microgravity induced bone loss are thus essential. Considering the similarities of space and aging induced osteopenia, an indisputable benefit of such a prophylaxis would be its potential as a treatment for the bone loss which plagues over 25 million people in the U.S. The osteogenic potential of mechanical strain is strongly frequency dependent, with sensitivity increasing up through at least 60 Hz (cycles per second). One hundred seconds per day of a 1 Hz cyclic loading will inhibit disuse osteopenia only if sufficient in magnitude to engender 1000 microstrain (mu(epsilon)) in the tissue. When loading is applied at 30 Hz, however, mechanical strains on the order of 5O mu(epsilon) (approx. 1% of the peak strains which occur in bone during vigorous functional activity), can stimulate bone formation in a duration dependent manner. In longer term animal studies, strains of less than 10 mu(epsilon), induced non-invasively via a whole body vibration, will stimulate bone formation on the surfaces of

trabeculae, increase bone density, and improve strength. Finally, preliminary results from a double blind prospective clinical trial shows promise in inhibiting the bone loss which parallels the menopause. Based on these observations, we propose that these high frequency, low magnitude, mechanical strains effectively serve as a ”surrogate” for musculoskeletal ground reaction forces, and thus represent an ideal countermeasure to the osteopenia which parallels microgravity conditions. The specific goal of this NASA funded work is to identify genes in bone upregulated by disuse, and to determine the efficacy of an osteogenic mechanical stimulus to downregulate their expression.
Author
Genes; Aerospace Medicine; Biodynamics; Bone Demineralization; Countermeasures; Microgravity; Musculoskeletal System

20000020534 Johns Hopkins Univ., Baltimore, MD USA
Skeletal Structural Consequences of Reduced Gravity Environments
Ruff, C. B., Johns Hopkins Univ., USA; Beck, T. J., Johns Hopkins Univ., USA; Newman, D., Johns Hopkins Univ., USA; Oden, M., Johns Hopkins Univ., USA; Shaffner, G., Johns Hopkins Univ., USA; LeBlanc, A., Johns Hopkins Univ., USA; Shackelford, L., Johns Hopkins Univ., USA; Rianon, N., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 232-233; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Human physical activity in terrestrial environments is enabled by muscle forces acting through the levers of the long bones to move the body’s mass against the earth’s gravitational field. The loading forces generated in the skeleton are believed to be the stimulus for structural adaptation of bone to maintain skeletal strains within certain intrinsic limits. Exceeding strain set limits with consistent strenuous exercise is believed to stimulate new bone formation while strains consistently below set limits, as in disuse or microgravity, cause bone loss. The removal of mechanical stimulus in disuse or exposure to microgravity results in the rapid loss of muscle mass followed by the slower but inexorable loss of bone. In prolonged space-flight, astronauts and cosmonauts experience highly variable patterns of bone loss, probably because of variations in the effects of microgravity as well as local variations in the efficacy of exercise countermeasures. The main consequence of loss of bone is an increase in bone fragility, but the structural consequences of bone loss, i.e., the risk of catastrophic failure, cannot be ascertained by conventional metrics of skeletal bone mass. The principle goals of this project are to use engineering methods to assess the structural consequences of prolonged weightlessness. Work involves the extraction of structural information from bone mass data on astronauts, cosmonauts and bed-rest subjects as well as the use of x-ray computed tomography on the tail suspended rat model.
Author
Human Reactions; Bone Demineralization; Countermeasures; Exposure; Losses; Microgravity; Musculoskeletal System; Physical Exercise

20000020535 Johns Hopkins Univ., Baltimore, MD USA
The Effects of Partial Mechanical Loading and Ibandronate on Skeletal Tissues in the Adult Rat Hindquarter Suspension Model of Microgravity
Schultheis, Lex, Johns Hopkins Univ., USA; Shapiro, Jay, Walter Reed Army Medical Center, USA; Bloomfield, Sue, Texas A&M Univ., USA; Fedarko, Neal, Johns Hopkins Univ., USA; Thierry-Palmer, Myrtle, Morehouse School of Medicine, USA; Ruff, Christopher, Johns Hopkins Univ., USA; Ruiz, Jennifer, Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 234; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The elimination of weight bearing force in microgravity uncouples bone formation from bone resorption resulting in net bone loss. Gravity imposed mechanical loading can mitigate these effects of diminished mechanical strain. However quantitative assessment of gravity titration as a mechanical countermeasure in a ground-based animal model has not yet been studied. We will determine the level of mechanical loading required to maintain bone remodeling in the face of weightlessness as well as the role of antiresorptive agents under this condition. Graded mechanical loading on forepaws starting at 50% body weight vs. unloaded hindlimbs is applied through a novel servo-controlled platform that is the floorplate of each cage. An infrared optical system quantitatively resolves a total displacement of 2 mm caused by a 100 gram weight to within 5%. The activity of the animals is monitored continuously. The relationship between ground reaction forces and humerus bone strain is being concurrently investigated. Critical parameters under investigation include the magnitudes, repetition rates and frequency (Fourier) spectrum of applied forces and their associated bone strain history. Antiresorptive agents have been shown to decrease bone resorption and to increase bone mass. Ibandronate is a third- generation bisphosphonate which can be administered intravenously at 3 month intervals with little systemic toxicity. Using the rat adult (250-300 gm) hindquarter 35-day suspension model, parameters of bone biomechanics, bone mineral density, bone histomorphology and biochemistry are measured. Assessment includes vitamin D metabolites, and 24 hour urine catecholamine production and dry adrenal mass as parameters of stress. Ten simultaneous animal suspension systems are operational. Continuously monitored impact profiles have been recorded during suspension with 50% weight bearing and in free roaming controls. Bone mineral density has been recorded using peripheral quantitative computed

tomography (pQCT). Bone marrow stromal fibroblasts (osteoprogenitor cells) have been isolated from suspended and control animals. We hypothesize that the combination of a critical amount mechanical loading and an antiresorptive agent will maintain normal bone remodeling in the face of microgravity.
Author
Adrenal Gland; Biochemistry; Biodynamics; Bone Demineralization; Bone Marrow; Countermeasures; Gravitation; Humerus

20000020536 NASA Johnson Space Center, Houston, TX USA
Bone Loss in Space: Shuttle/MIR Experience and Bed Rest Countermeasure Program
Shackelford, L. C., NASA Johnson Space Center, USA; LeBlanc, A., Baylor Coll. of Medicine, USA; Feiveson, A., NASA Johnson Space Center, USA; Oganov, V., Institute of Biomedical Problems, USSR; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 235; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Loss of bone mineral during space flight was documented in the 1970's Skylab missions. The USSR space program made similar observations in the 1980's. The Institute of Biomedical Problems in Moscow and NASA JSC in 1989 began to collect pre- and post-flight bone mineral density (BMD) using Hologic QDR 1000 DEXA scanners transferred from JSC to Moscow and Star City. DEXA whole body, hip, and lumbar spine scans were performed prior to and during the first week after return from 4- to 6-month missions (plus one 8-month mission and one 14- month mission) on the Mir space station. These data documented the extent and regional nature of bone loss during long duration space flight. of the 18 cosmonauts participating in this study between 1990 and 1995, seven flew two missions. BMD scans prior to the second flight compared to the first mission preflight scans indicated that recovery was possibly delayed or incomplete. Because of these findings, NASA and IBMP initiated the study "Bone Mineral Loss and Recovery After Shuttle/Mir Flights" in 1995 to evaluate bone recovery during a 3-year post-flight period. All of the 14 participants thus far evaluated lost bone in at least one region of the spine and lower extremities during flight. Of the 14, only one to date has exhibited full return to baseline BNM values in all regions. The current study will continue until the last participant has reached full bone recovery in all regions, has reached a plateau, or until three years after the flight (2001 for the last mission of the program). Bone mineral density losses in space and difficulty in returning to baseline indicate a need for countermeasure development. In late 1996 NASA JSC and Baylor College of Medicine were approved to conduct two countermeasure studies during 17 weeks of bed rest. In 1997 the studies were begun in the bed rest facility established by NASA, Baylor College of Medicine, and The Methodist Hospital in Houston. To date, three bed rest controls, five resistive exercisers, and four subjects taking alendronate (a bisphoshonate that inhibits osteoclastic resorption of bone) have completed 17 weeks bed rest. In contrast to information currently available from space flight (n=28) and bed rest (n= 12) in which all individuals experienced bone loss in at least one region, one of four subjects taking alendronate and one of five subjects performing heavy resistive exercise at bed rest fully maintained bone density in all regions of the spine and lower extremities. Overall results of both countermeasures which will be presented are encouraging. The study will be completed by mid to late 2000 with 10 subjects in each of three groups.
Author
Bone Demineralization; Bed Rest; Countermeasures; Losses; Physical Exercise

20000020538 NASA Ames Research Center, Moffett Field, CA USA
Non-Invasive Investigation of Bone Adaptation in Humans to Mechanical Loading
Whalen, R., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 239-241; In English
Contract(s)/Grant(s): NCC2-5088; NCC2-5186; RTOP 199-26-12-35; DVA Proj. B802-RA; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Experimental studies have identified peak cyclic forces, number of loading cycles, and loading rate as contributors to the regulation of bone metabolism. We have proposed a theoretical model that relates bone density to a mechanical stimulus derived from average daily cumulative peak cyclic 'effective' tissue stresses. In order to develop a non-invasive experimental model to test the theoretical model we need to: (1) monitor daily cumulative loading on a bone, (2) compute the internal stress state(s) resulting from the imposed loading, and (3) image volumetric bone density accurately, precisely, and reproducibly within small contiguous volumes throughout the bone. We have chosen the calcaneus (heel) as an experimental model bone site because it is loaded by ligament, tendon and joint contact forces in equilibrium with daily ground reaction forces that we can measure; it is a peripheral bone site and therefore more easily and accurately imaged with computed tomography; it is composed primarily of cancellous bone; and it is a relevant site for monitoring bone loss and adaptation in astronauts and the general population. This paper presents an overview of our recent advances in the areas of monitoring daily ground reaction forces, biomechanical modeling of the forces on the calcaneus during gait, mathematical modeling of calcaneal bone adaptation in response to

cumulative daily activity, accurate and precise imaging of the calcaneus with quantitative computed tomography (QCT), and application to long duration space flight.
Author
Bone Demineralization; Bone Mineral Content; Mathematical Models; Residual Stress; Loading Rate; Cyclic Loads

20000020539 NASA Johnson Space Center, Houston, TX USA
Renal Stone Risk During Space Flight
Whitson, Peggy A., NASA Johnson Space Center, USA; Pietrzyk, Robert A., Wyle Life Sciences, USA; Sams, Clarence F., NASA Johnson Space Center, USA; Pak, Charles Y. C., Texas Univ. Health Science Center, USA; Jones, Jeffrey A., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 242; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Space flight produces a number of metabolic and physiological changes in the crewmembers exposed to microgravity. Following launch, body fluid volumes, electrolyte levels, and bone and muscle undergo changes as the human body adapts to the weightless environment. Changes in the urinary chemical composition may lead to the potentially serious consequences of renal stone formation. Previous data collected immediately after space flight indicate changes in the urine chemistry favoring an increased risk of calcium oxalate and uric acid stone formation (n = 323). During short term Shuttle space flights, the changes observed include increased urinary calcium and decreased urine volume, pH and citrate resulting in a greater risk for calcium oxalate and brushite stone formation (n = 6). Results from long duration Shuttle/Mir missions (n = 9) followed a similar trend and demonstrated decreased fluid intake and urine volume and increased urinary calcium resulting in a urinary environment saturated with the calcium stone-forming salts. The increased risk occurs rapidly upon exposure to microgravity, continues throughout the space flight and following landing. Dietary factors, especially fluid intake, or pharmacologic intervention can significantly influence the urinary chemical composition. Increasing fluid intake to produce a daily urine output of 2 liters/day may allow the excess salts in the urine to remain in solution, crystals formation will not occur and a renal stone will not develop. Results from long duration crewmembers (n = 2) who had urine volumes greater than 2.5 L/day minimized their risk of renal stone formation. Also, comparisons of stone-forming risk in short duration crewmembers clearly identified greater risk in those who produced less than 2 liters of urine/day. However, hydration and increased urine output does not correct the underlying calcium excretion due to bone loss and only treats the symptoms and not the cause of the increased urinary salts. Dietary modification and promising pharmacologic treatments may also be used to reduce the potential risk for renal stone formation. Potassium citrate is being used clinically to increase the urinary inhibitor levels to minimize the development of crystals and the growth of renal stones. Bisphosphonates are a class of drugs recently shown to help in patients with osteoporosis by inhibiting the loss of bones in elderly patients. This drug could potentially prevent the bone loss observed in astronauts and thereby minimize the increase in urinary calcium and reduce the risk for renal stone development. Results of NASA's renal stone risk assessment program clearly indicate that exposure to microgravity changes the urinary chemical environment such that there is an increased risk for supersaturation of stone-forming salts, including calcium oxalaie and brushite. These studies have indicated specific avenues for development of countermeasures for the increased renal stone risk observed during and following space flight. Increased hydration and implementation of pharmacologic countermeasures should largely mitigate the in-flight risk of renal stones.
Derived from text
Body Fluids; Bone Demineralization; Calcium; Chemical Composition; Countermeasures; Losses; Metabolism; Microgravity; Muscles

20000020540 NASA Ames Research Center, Moffett Field, CA USA
Bone Proteoglycan Changes During Skeletal Unloading
Yamauchi, M., North Carolina Univ., USA; Uzawa, K., North Carolina Univ., USA; Pornprasertsuk, S., North Carolina Univ., USA; Arnaud, S., NASA Ames Research Center, USA; Grindeland, R., NASA Ames Research Center, USA; Grzesik, W., North Carolina Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 243-244; In English Contract(s)/Grant(s): NAG2-1188; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Skeletal adaptability to mechanical loads is well known since the last century. Disuse osteopenia due to the microgravity environment is one of the major concerns for space travelers. Several studies have indicated that a retardation of the mineralization process and a delay in matrix maturation occur during the space flight. Mineralizing fibrillar type I collagen possesses distinct cross-linking chemistries and their dynamic changes during mineralization correlate well with its function as a mineral organizer. Our previous studies suggested that a certain group of matrix proteoglycans in bone play an inhibitory role in the mineralization process through their interaction with collagen. Based on these studies, we hypothesized that the altered mineralization during

spaceflight is due in part to changes in matrix components secreted by cells in response to microgravity. In this study, we employed hindlimb elevation (tail suspension) rat model to study the effects of skeletal unloading on matrix proteoglycans in bone.
Author
Bone Demineralization; Unloading; Proteins; Musculoskeletal System; Microgravity

20000020541 Texas Univ., Dallas, TX USA
The Effects of Twelve Weeks of Bedrest on Bone Histology, Biochemical Markers of Bone Turnover, and Calcium Homeostasis in Eleven Normal Subjects
Zerwekh, J. E., Texas Univ., USA; Ruml, L. A., Texas Univ., USA; Gottschalk, F., Texas Univ., USA; Pak, C. Y. C., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 245-247; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gravity is recognized as an important factor in the normal growth and maintenance of the skeletal system. The mechanism(s) by which gravity affects skeletal growth and remodeling are not known, but in its absence, such as during space flight or prolonged immobilization, the result is a rapid loss of bone mineral. If of sufficient duration and magnitude, such losses of bone mineral could lead to fracture. In addition, increased urinary concentration of stone-forming salts would increase the risk for kidney stone formation. In order to prevent such losses during skeletal unloading, effective countermeasures must be directed at preventing the underlying defect in bone metabolism. In order to better understand the nature of the skeletal defect(s) which contribute to this loss of bone mineral, we examined the effects of twelve weeks of bedrest on bone metabolism and calcium homeostasis in eleven normal volunteers. This was accomplished via the use of bone histomorphometry and measurement of calcitropic hormones and biochemical markers of bone turnover.
Author
Bed Rest; Musculoskeletal System; Histology; Biochemistry; Homeostasis

20000020542 NASA Johnson Space Center, Houston, TX USA
Cardiovascular Session Summary
Raven, Peter, University of North Texas Health Science Center, USA; Schneider, Sue, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 249-256; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It was apparent that the bed-rest and spaceflight data indicated that decreases in plasma volume and cardiac atrophy along with cardiac remodeling were fundamental changes which predisposed many astronauts to post flight orthostatic intolerance. Despite the recently acquired in-flight and post-flight muscle sympathetic nerve activity findings suggesting that the sympathetic nerve responses were appropriate there remains significant contrary data from bed-rest studies, post- flight stand tests and hind-limb unweighted rat studies that suggest that the vasoconstrictive responses were compromised at least insufficient in susceptible individuals. The key issues raised is whether a diminished increase in sympathetic activity from baseline without changes in 254 First Biennial Space Biomedical Investigators'Workshop Cardiovascular peak response or receptor adaptations is an abnormal response or is an individual variance of response to the accentuated decrease in stroke volume. Data relating autonomic neural control of heart rate were presented to suggest that the vagal and sympathetic control of heart rate was attenuated. Also, bed-rest and space flight induced attenuated baroreflex control of heart rate was shown to be restored to pre-bedrest function by one bout of maximal dynamic exercise. However, these data were confounded by relying on the use of R-R interval as a measure of efferent responses of the baroreflex during a condition in which the baseline heart rate was changed. Clearly the idea that the autonomic control of heart rate may be changed by microgravity needs further investigation. This direction is suggested despite the fact that in the triple product (HR x SV x TPR = MAP) assessment of the regulation of arterial blood pressure during orthostasis the role of the HR reflex may be less influential than that associated. with cardiac atrophy (SV changes) and aberrant sympathetic vasoconstriction (resistance) changes. Although sympathetic nerve activity responses in-flight and post-flight on neurolab appeared appropriate, enough bed-rest and post-flight stand test data, along with animal model data suggest that vasoconstriction was compromised. The mechanism of this compromised vasoconstriction needs to be delineated. Other major findings concerning microgravity and physiological regulatory systems are that: I . Thermoregulatory adaptation appear to suggest some decrements in the control of cutaneous vasodilation and sweating; 2. Calcium resorption and dietary calcium need to be defined for differing durations of spaceflight, especially as the effects of excess calcium on vasomotor function appears to be detrimental; 3. Neurohumoral mechanisms of microgravity induced changes in neural function and the regulation of plasma volume and total body water, bone resorption and autonomic neural control of the circulation need further delineation; 4. As performance of work

tasks become prolonged, the mechanisms of blood pressure regulation in microgravity needs to be used in the recovery period from prolonged work tasks.
Derived from text
Cardiovascular System; Bed Rest; Plasma Chemistry; Abnormalities; Activity (Biology); Autonomic Nervous System; Bone Demineralization; Heart Function; Heart Rate; Microgravity; Muscular Function

20000020544 Medical Univ. of South Carolina, Gazes Cardiac Research Inst., Charleston, SC USA
Mechanisms for Load Control of Cardiac Mass: Cell Culture Studies in Adult Cardiomyocytes using a 3-D Collagen Matrix
Baicu, C. F., Medical Univ. of South Carolina, USA; Turner, J. H., Medical Univ. of South Carolina, USA; Young, V. D., Medical Univ. of South Carolina, USA; Barnes, M., Medical Univ. of South Carolina, USA; Zile, M. R., Medical Univ. of South Carolina, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 258; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Growth regulation in the adult myocardium is controlled by a complex interaction of mechanical, neurohormonal and growth factors. The purpose of this study was to use in-vitro primary cell culture techniques to isolate hemodynamic and mechanical determinants of cardiac muscle cell growth without making simultaneous changes in other potential factors.
Author
Loads (Forces); Heart; Cells (Biology); Myocardium; Hemodynamic Responses; Research

20000020546 Army Inst. of Surgical Research, Fort Sam Houston, TX USA
Application of Acute Maximal Exercise to Enhance Mechanisms Underlying Blood Pressure Regulation and Orthostatic Tolerance After Exposure to Simulated Microgravity
Convertino, V. A.; Engelke, K. A.; Doerr, D. F.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 260-262; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Development of orthostatic hypotension and intolerance in astronauts who return to earth following a spaceflight mission represents a significant operational concern to NASA. Reduced plasma volume, vascular resistance, and baroreflex responsiveness following exposure to actual and ground-based analogs of microgravity have been associated with orthostatic instability, suggesting that these mechanisms may contribute alone or in combination to compromise of blood pressure regulation after spaceflight. It therefore seems reasonable that development of procedures designed to reverse or restore the effects of microgravity on regulatory mechanisms of blood volume, vascular resistance and cardiac function should provide some protection against postflight orthostatic intolerance. Several investigations have provided evidence that a single bout of exhaustive dynamic exercise enhances functions of mechanisms responsible for blood pressure stability. Therefore, the purpose of our research project was to conduct a series of experiments using ground-based analogs of reduced gravity (i.e., prolonged restriction to the upright standing posture) in human subjects to investigate the hypothesis that a single bout of dynamic maximal exercise would restore blood volume, vascular resistance and cardiac function and improve blood pressure stability.
Author
Blood Pressure; Cardiovascular System; Heart Function; Microgravity; Orthostatic Tolerance; Plasma Chemistry

20000020547 Presbyterian Hospital of Dallas, Inst. for Exercise and Environmental Medicine, Dallas, TX USA
Potential Mechanism Leading to Impaired Thermoregulation Following Microgravity Exposure
Crandall, C. G., Presbyterian Hospital of Dallas, USA; Etzel, R. A., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 267-270; In English
Contract(s)/Grant(s): NAGW-3582; NAG9-1033; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Prolonged exposure to microgravity or its analogues impairs thermoregulation in humans evidenced by higher internal temperatures following the exposure during a thermal challenge. Although the mechanism leading to this response has not been clearly delineated, we identified that prolonged head-down tilt (HDT) markedly impairs thermoregulatory reflex control of skin blood flow, as demonstrated by an increased internal temperature threshold for cutaneous vasodilation, and by a reduced slope of the relationship between the elevation in skin blood flow relative to the elevation in internal temperature. Recently, Fortney et al. identified similar responses in two individuals following 115 days of microgravity exposure. One possible mechanism leading to altered cutaneous vasodilation during a thermal challenge following actual or simulated microgravity exposure may be associated with baroreflex-mediated attenuation in the elevation of skin blood flow. During a heat stress the elevation in skin blood flow is accomplished through a combination of increased cutaneous vascular conductance and cardiac output, both of which result in central venous pressure (CVP) decreasing 2-6 mmHg. Reductions in CVP of this magnitude in normothermia decrease muscle blood flow and skin blood flow presumably through unloading the cardiopulmonary baroreceptors. It is unclear whether

the reduction in CVP, and accompanying cardiopulmonary baroreceptor unloading, during passive heating buffers the elevation in skin blood flow. That is, would the elevation in skin blood flow be greater if CVP did not decrease, or decreased to a lesser extent during the heat stress? Conversely, if CVP decreased to a greater extend during a thermal challenge following a perturbation such as prolonged HDT, would the elevation in skin blood flow be attenuated during that thermal challenge? Given that prolonged HDT decreases plasma volume and central venous pressure, such a finding would provide a plausible hypothesis to explain why skin blood flow does not increase to the same extent during a heat stress following simulated or actual microgravity exposure. Thus, the purpose of this project was to identify whether cardiopulmonary baroreceptor unloading coincident with heat stress buffers the elevation in skin blood flow.
Author
Heat Tolerance; Thermoregulation; Microgravity; Physiological Responses; Plasma Chemistry; Heart Function; Cardiovascular System; Analogs

20000020548 Virginia Commonwealth Univ., Medical Coll. of Virginia, Richmond, VA USA
Autonomic Consequences of Microgravity Exposure
Eckberg, Dwain L., Virginia Commonwealth Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 271-273; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Human autonomic stretch and chemical receptors continuously sense changes of body position, arterial pressure, blood volume, blood chemistry, metabolic activity, and exercise, and orchestrate finely tuned changes of efferent sympathetic and vagal nerve traffic to diverse organs. When astronauts enter microgravity, the quality and quantity of receptor inputs change in major ways. Immediately, distension of the heart and arteries in the upper body increases. As exposure to microgravity continues, however, blood volume and distension of the heart and upper body decrease. Upon return to gravity, most astronauts experience difficulty standing: their heart rates increase to levels above those experienced before exposure to microgravity, their arterial pressures may fall, and they may even lose consciousness. My laboratory has longstanding interest in these autonomic changes, and has over many years sought to characterize them before, during, and after space missions. Space studies have been complemented by ground based research in healthy volunteers and patients with orthostatic syncope. This total effort has helped to define basic human physiological mechanisms. In particular, recent efforts have helped to delineate autonomic mechanisms involved with interventions that may lead to hypotension, including major exercise, and standing.
Author
Microgravity; Autonomic Nervous System; Laboratories; Metabolism; Hypotension; Heart Rate; Exposure; Chemical Composition

20000020549 NASA Johnson Space Center, Houston, TX USA
Gender-Related Differences in Cardiovascular Responses to Orthostatic Stress
Fritsch-Yelle, Janice M., NASA Johnson Space Center, USA; DAunno, Dominick S., National Space Biomedical Research Inst., USA; Waters, Wendy W., National Space Biomedical Research Inst., USA; Freeman-Perez, Sondra, Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 274-275; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

There is evidence that men and women have different cardiovascular responses to standing, and that women are more susceptible to orthostatic hypotension than men. The present study seeks to determine if decreased orthostatic tolerance in women is caused by diminished vasoconstrictive responses.
Author
Physiological Responses; Cardiovascular System; Hypotension

20000020550 Beth Israel Deaconess Medical Center, Margaret and H. A. Rey Lab. for Nonlinear Dynamics in Medicine, Boston, MA USA
Heart Rate Dynamics During Microgravity: Bedrest and Spaceflight Studies
Goldberger, A. L., Beth Israel Deaconess Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 276-277; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In collaboration with investigators at NASA and the Russian Space Program, we have been involved with a series of collaborative studies on analysis of heart rate dynamics during both terrestrial bedrest deconditioning studies and long-duration spaceflight aboard Mir. Our objectives are: 1) To compile and analyze digitized databases (preflight, during flight, and postflight) of continuous ECG recordings from de-identified crew members from U.S. Spacelab Life Sciences and Shuttle missions, as well as Russian Mir missions. 2) to test the hypotheses that: (a) loss of complex heart rate variability is a useful new index of cardiac deconditioning and space sickness during space flight, as well as during microgravity simulations with bedrest; and (b) to

quantitatively assess the effects of countermeasures such as LBNP and exercise. 3) to analyze electrocardiographic data from spaceflight and microgravity simulations for evidence of potentially serious cardiac electrical instability and its precursors. and 4) to analyze subtle alterations in diurnal cycle dynamics in order to better understand the 46 ”restorative” function of sleep.
Author
Heart Rate; Microgravity; Bed Rest; Space Flight; Data Bases; Space Adaptation Syndrome; Motion Sickness; Lower Body Negative Pressure; Electrocardiography

20000020555 Presbyterian Hospital of Dallas, Inst. for Exercise and Environmental Medicine, Dallas, TX USA
The Effect of Cardiac Mechanics on Orthostatic Intolerance Following Bed Rest
Levine, Benjamin D., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 286-287; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gravitational and hydrostatic gradients play an essential role in determining the distribution of pressure and volume within the cardiovascular system. When these gradients are removed or minimized, such as during spaceflight or its ground-based simulations (head-down tilt bed rest), a central fluid shift occurs, initiating a neurohumorally mediated reduction in both blood/plasma and ventricular volume. Diastolic wall stress is thereby decreased and the volume load of the left ventricle is reduced compared to the supine position at I G. This adaptation is rapid, and appears to be substantially complete within the first 24-48 hours of microgravity exposure. Compounding these hemodynamic changes is a reduction in physical activity associated with confinement, which minimizes chronotropic and pressure work compared to more freely ambulatory periods. Within a few weeks of real or simulated microgravity, the heart appears to atrophy, presumably in response to reduced myocardial work. This cardiac atrophy results in impaired diastolic function characterized by decreased ventricular distensibility, and possibly by loss of diastolic suction leading to reduced ventricular filling. The combination of atrophy and hypovolemia results in a prominent reduction in stroke volume in the upright position at I G, which is the essential stimulus for microgravity induced orthostatic hypotension. Although the hypovolemia of spaceflight or bed rest appears to plateau after 24-48 hours of real or simulated microgravity, preliminary data obtained by the PI in three subjects who have completed 12 weeks of bed rest has failed to identify a plateau in the loss of cardiac mass measured by MRI. Moreover, 2 additional subjects have been studied through 6 weeks of supine bed rest (total n=5) allowing statistical analysis at this time point.
Derived from text
Cardiovascular System; Bed Rest; Diastole; Heart; Hemodynamic Responses; Microgravity; Myocardium; Physiological Responses; Pressure Distribution; Stroke Volume

20000020556 Yale Univ. School of Medicine, John B. Pierce Lab., New Haven, CT USA
Renal Sodium Handling After Exercise Induced Plasma Volume Expansion
Mack, G. W., Yale Univ. School of Medicine, USA; Kavouras, S. A., Yale Univ. School of Medicine, USA; Nagashima, K., Yale Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 288-289; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is generally agreed that reduced orthostatic tolerance post space flight in astronauts is due, in part, to a reduction in plasma volume. It is also believed that exercise will be a critical component of any remedy used counter the ”maladaptive” response to prolonged space flight. Within this context it is believed that exercise training and its accompanying hypervolemia could be used to offset the reduction on plasma volume associated with space flight. Thus, it is essential that the basic mechanisms responsible for plasma volume expansion be elucidated. Plasma volume expansion during exercise training is essentially isotonic. It has been proposed that increased salt retention could account for the elevation in plasma volume during exercise training yet little direct data supporting this hypothesis exists. The purpose of this investigation was to examine the role of renal sodium handling on exercise induced plasma volume expansion.
Author
Sodium; Physical Exercise; Plasma Chemistry; Hypervolemia

20000020557 Massachusetts Inst. of Tech., Cambridge, MA USA
Cardiovascular System Identification of Alterations in Cardiovascular Regulation During Simulated Space Flight
Mullen, T. J., Massachusetts Inst. of Tech., USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Harvard Medical School, USA; Williams, G. H., Harvard Medical School, USA; Cohen, R. J., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators’ Workshop; 1999, pp. 290-292; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Alterations in cardiovascular regulation and function that occur during and after space flight have been reported. These alterations are manifested, for example, by reduced orthostatic tolerance upon reentry to the earth’s gravity from space. However,

the precise physiologic mechanisms responsible for these alterations remain to be fully elucidated. Perhaps, as a result, effective countermeasures have yet to be developed. In this study we apply a powerful, new method - cardiovascular system identification (CSI) - for the study of the effects of space flight on the cardiovascular system so that effective countermeasures can be developed. Cardiovascular System Identification (CSI) involves the mathematical analysis of second-to-second fluctuations in non-invasively measured heart rate, arterial blood pressure (ABP), and instantaneous lung volume (ILV - respiratory activity) in order to characterize quantitatively the physiologic mechanisms responsible for the couplings between these signals. Through the characterization of all the physiologic mechanisms coupling these signals, CSI provides a model of the closed-loop cardiovascular regulatory state in an individual subject. The model includes quantitative descriptions of the heart rate baroreflex as well as other important physiologic mechanisms. With an additional non-invasive measurement of stroke volume (SV - ultrasound Doppler method), the model may be extended to also include the characterization of the peripheral resistance baroreflex - which may play a central role in the development of orthostatic intolerance - and measures of systolic and diastolic function. We apply CSI in conjunction with the two general protocols of the human studies core. The first protocol involves ground-based, human bed-rest to simulate microgravity and standing to provide an orthostatic challenge. The second protocol is the same as the first but with the addition of circadian rhythm disruption to determine whether such disruption contributes to cardiovascular alterations. In these studies, we focus on the basic physiologic mechanisms responsible for the alterations in cardiovascular regulation and function during the simulated microgravity in order to formulate hypotheses regarding what countermeasures are likely to be most effective. In future studies, we plan to apply CSI to test the potential countermeasures in conjunction with the same bed-rest model. We also anticipate applying CSI for studying astronauts before and after space flight and ultimately, during space flight. The application of CSI promises to provide information relevant to the development and evaluation of effective countermeasures allowing humans to adapt appropriately upon reentry to the earth's gravity and to live and work for longer periods of time in microgravity.

Author

Space Flight; Simulation; Cardiovascular System; Blood Pressure; Circadian Rhythms; Countermeasures; Feedback Control; Heart Rate; Stroke Volume

20000020558 Massachusetts Inst. of Tech., Cambridge, MA USA

Non-Invasive Assessment of Susceptibility to Ventricular Arrhythmias During Simulated Space Flight

Mullen, T. J., Harvard Medical School, USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Harvard Medical School, USA; Williams, G. H., Harvard Medical School, USA; Cohen, R. J., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 293-294; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

There are numerous anecdotal reports that suggest that space flight may increase the incidence of ventricular tachyarrhythmias, including one documented episode of a 14 beat run of ventricular tachycardia during a Mir mission. However, it is not known whether space flight actually does decrease ventricular electrical stability. It is extremely important to assess whether long duration space flight predisposes the heart to life-threatening ventricular arrhythmias - particularly with regard to planning a possible mission to mars. However, experience in clinical medicine on earth has shown that commonly used non-invasively risk stratifiers (e.g. signal averaged electrocardiogram (SAECG), QT dispersion, heart rate variability, baroreceptor sensitivity, left ventricular ejection fraction, and the presence of non-sustained ventricular tachycardia on Holter monitoring) are not very accurate predictors of the occurrence of sudden cardiac death (SCD), sustained ventri!cular tachycardia (VF), or ventricular fibrillation (VF). It is generally believed that invasive electrophysiologic testing (EP) is more accurate, but this procedure is highly invasive and not risk free. Recently, with NASA support, a new technique - the measurement of microvolt level T wave alternans (TWA) - has been developed. In a series of clinical studies in varied patient populations this technique has proven superior to other non-invasive risk stratifiers as a predictor of SCD, VT and VF. TWA has been found in various studies to be equivalent to or superior to EP. In this project we apply the measurement of TWA, along with other risk stratifiers, to determine whether simulated microgravity increases the risk of ventricular tachyarrhythmias.

Author

Arrhythmia; Simulation; Tachycardia; Synchronism; Stability; Microgravity; Fibrillation

20000020559 Pennsylvania State Univ., Noll Physiological Research Center, University Park, PA USA

Postural Regulation of Muscle Sympathetic Nerve Activity Before and After Simulated and Actual Microgravity Deconditioning

Pawelczyk, J. A., Pennsylvania State Univ., USA; Levine, B. D., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 295-296; In English

Contract(s)/Grant(s): NAS9-19429; NAS9-19573; NAGW-3582; NAGW-4389; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The etiology of orthostatic intolerance after spaceflight is multifaceted. Morphological adaptations, in particular cardiac atrophy, are likely to magnify the decrease in stroke volume that occurs with reductions in cardiac filling pressure when standing. Neural adaptations may be inferred as well, as reductions in carotid-cardiac baroreflex responsiveness have been reported following bedrest deconditioning and spaceflight. Neural control of vascular resistance has not been studied directly when orthostatic intolerance is florid in the hours following spaceflight. However, the increases in systemic vascular resistance and plasma catecholamines during orthostatic stress are inappropriately low in orthostatically intolerant subjects following spaceflight, suggesting that deficits in the regulation of vascular resistance may be associated with hypoadrenergic function. The studies described in this abstract were designed to test this hypothesis.

Author

Muscular Function; Orthostatic Tolerance; Plasma Chemistry; Neck (Anatomy); Microgravity; Deconditioning; Etiology

20000020560 State Univ. of New York, Buffalo, NY USA

Influence of Gravity on Blood Volume and Flow Distribution

Pendergast, D., State Univ. of New York, USA; Olszowka, A., State Univ. of New York, USA; Bednarczyk, E., State Univ. of New York, USA; Shykoff, B., State Univ. of New York, USA; Farhi, L., State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 297-299; In English

Contract(s)/Grant(s): NAS9-16042; NAGW-3937; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In our previous experiments during NASA Shuttle flights SLS 1 and 2 (9-15 days) and EUROMIR flights (30-90 days) we observed that pulmonary blood flow (cardiac output) was elevated initially, and surprisingly remained elevated for the duration of the flights. Stroke volume increased initially and then decreased, but was still above 1 Gz values. As venous return was constant, the changes in SV were secondary to modulation of heart rate. Mean blood pressure was at or slightly below 1 Gz levels in space, indicating a decrease in total peripheral resistance. It has been suggested that plasma volume is reduced in space, however cardiac output/venous return do not return to 1 Gz levels over the duration of flight. In spite of the increased cardiac output, central venous pressure was not elevated in space. These data suggest that there is a change in the basic relationship between cardiac output and central venous pressure, a persistent "hyperperfusion" and a re-distribution of blood flow and volume during space flight. Increased pulmonary blood flow has been reported to increase diffusing capacity in space, presumably due to the improved homogeneity of ventilation and perfusion. Other studies have suggested that ventilation may be independent of gravity, and perfusion may not be gravity- dependent. No data for the distribution of pulmonary blood volume were available for flight or simulated microgravity. Recent studies have suggested that the pulmonary vascular tree is influenced by sympathetic tone in a manner similar to that of the systemic system. This implies that the pulmonary circulation is dilated during microgravity and that the distribution of blood flow and volume may be influenced more by vascular control than by gravity. The cerebral circulation is influenced by sympathetic tone similarly to that of the systemic and pulmonary circulations; however its effects are modulated by cerebral autoregulation. Thus it is difficult to predict if cerebral perfusion is increased and if there is edema in space. Anecdotal evidence suggests there may be cerebral edema early in flight. Cerebral artery velocity has been shown to be elevated in simulated microgravity. The elevated cerebral artery velocity during simulated microgravity may reflect vasoconstriction of the arteries and not increased cerebral blood flow. The purpose of our investigations was to evaluate the effects of alterations in simulated gravity (+/-), resulting in changes in cardiac output (+/-), and on the blood flow and volume distribution in the lung and brain of human subjects. The first hypothesis of these studies was that blood flow and volume would be affected by gravity, but their distribution in the lung would be independent of gravity and due to vasoactivity changing vascular resistance in lung vessels. The vasodilitation of the lung vasculature (lower resistance) along with increased "compliance" of the heart could account for the absence of increased central venous pressure in microgravity. Secondly, we postulate that cerebral blood velocity is increased in microgravity due to large artery vasoconstriction, but that cerebral blood flow would be reduced due to autoregulation.

Author

Blood Flow; Blood Volume; Gravitational Effects; Automatic Control; Brain Circulation; Cardiovascular System; Flow Distribution

20000020564 NASA Johnson Space Center, Houston, TX USA

Evaluation of Thermoregulation After Spaceflight

Schneider, S. M., NASA Johnson Space Center, USA; Williams, W. J., Wyle Labs., Inc., USA; Greenleaf, J. E., NASA Ames Research Center, USA; Lee, S. M. C., Wyle Labs., Inc., USA; Gonzalez, R., Army Research Inst. of Environmental Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 308-309; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Altered thermoregulation has been reported following spaceflight simulations such as water immersion and bedrest but it has never been evaluated immediately after actual spaceflight. Impaired thermoregulation may have significant impact during various spaceflight activities such as countermeasure exercise, extravehicular activity (EVA), landing, and egress. It would be manifested as an increased body temperature and heart rate and decreased work capacity and endurance. In this study we evaluated the exercise responses of two crewmembers following a long duration spaceflight and measured their changes in body temperatures, skin blood flow, sweating and heat production during a mild submaximal exercise stress.
Author
Evaluation; Thermoregulation; Simulation; Heart Rate; Extravehicular Activity; Countermeasures; Body Temperature

20000020565 Utah Univ., Biofluid Mechanics Lab., Salt Lake City, UT USA
Hydraulic and Computer Modeling of Cardiovascular Response to Weightlessness
Sharp, M. K., Utah Univ., USA; Pantalos, G. M., Utah Univ., USA; Gillars, K. J., Utah Univ., USA; Peterson, K., Utah Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 310-313; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Hydraulic and computer models of the systemic and pulmonary circulation have been developed for studying the acute effects of gravity on the cardiovascular system, including regional fluid shifting and the influence of hydrostatic pressure within the ventricle on diastolic ventricular filling, cardiac output and vascular pressures.
Author
Cardiovascular System; Computerized Simulation; Weightlessness; Hydraulic Analogies

20000020566 Hershey (Milton S.) Medical Center, Hershey, PA USA
Sympathetic Contributions to Orthostatic Tolerance and Vascular Tone Following Bed Rest
Shoemaker, J. Kevin, Hershey (Milton S.) Medical Center, USA; Sinoway, Lawrence I., Hershey (Milton S.) Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 314-316; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Augmentation of total peripheral resistance is critical for brain blood flow when cerebral perfusion pressure is diminished as one moves from the supine to the upright posture. Under these conditions increased total peripheral resistance is a function of changes in both stroke volume and peripheral vascular tone. In turn, vascular resistance is highly dependent upon a functioning sympathetic nervous system that can produce vasoconstriction in skeletal muscle and abdominal vascular beds. Current evidence suggests that blood vessel regulation may be altered by space flight, and its ground based analog of head-down tilt bed rest (HDBR), possibly contributing to the diminished orthostatic tolerance observed in many individuals following these interventions. We report on two studies that have examined the effects of 14 days HDBR on the relationship between sympathetic outflow and vascular resistance in humans.
Author
Sympathetic Nervous System; Orthostatic Tolerance; Vasoconstriction; Bed Rest; Physiological Responses; Cardiovascular System; Blood Flow

20000020567 Brigham and Women's Hospital, Boston, MA USA
Renal and Cardio-Endocrine Responses in Humans to Simulated Microgravity
Williams, Gordon H., Brigham and Women's Hospital, USA; Mullen, Thomas, Brigham and Women's Hospital, USA; Ramsdell, Craig, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 317-318; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The volume-regulating systems are integrated to produce an appropriate response to both acute and chronic volume changes. Their responses include changing the levels of the hormones and neural inputs of the involved systems and/or changing the responsiveness of their target tissues. Weightlessness produces a volume challenge which is unfamiliar to the organism. Thus, it is likely that the volume regulatory mechanisms may respond inappropriately, e.g., an inappropriate decrease in total body volume in space and abnormal responses to upright posture and stress on return to earth. A similar "inappropriateness" also can occur in disease states, e.g., congestive heart failure. While it is clear that weightlessness produces profound changes in sodium and volume homeostasis, the mechanisms responsible for these changes are incompletely understood. Confounding this analysis is sleep deprivation, common in space travel, which can also modify volume homeostatic mechanisms. There are two overarching hypotheses: simulated micro-gravity disrupts the renal and cardio-endocrine systems responses to steady state and acute stress,

with these disruptions being more profound in the salt-loaded than the salt-depleted state. and sleep deprivation has an additive adverse effect to microgravity on the responsiveness and regulation of the renal and cardio-endocrine homeostatic systems.
Author
Weightlessness; Simulation; Endocrine Systems; Renal Function; Microgravity

20000020568 Baylor Coll. of Medicine, Houston, TX USA
Immunology, Infectious Disease, and Hematology Session Summary
Shearer, William, Baylor Coll. of Medicine, USA; Sonnenfeld, Gerald, Morehouse School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 320-326; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The presentations of the Immunology, Infectious Disease, and Hematology Scientific Session are divided into four groups of common theme: immune responses in space travel, virus infections in space travel, biological effects of space travel, and health hazards and bacterial containment in space travel. It was clear from the extent of the discussion following each presentation that the general themes of immunology, infection, and toxicity and bacterial containment in long-term space travel have a particularly relevant importance for human survival and quality of life, based upon preliminary evidence of the participating researchers. Each presentation touched upon the possible risks of long-term space travel due to alteration in immune responses, reactivation of previously controlled infections, biological alterations in cell membrane function and gene activation, and toxic chemical and bacterial contamination.
Author
Immunology; Infectious Diseases; Hematology; Viruses; Biological Effects; Health; Hazards

20000020569 Baylor Coll. of Medicine, Houston, TX USA
Neocytolysis: Mechanisms of Monitoring Neocytes
Alfrey, C. P., Baylor Coll. of Medicine, USA; Rice, L., Baylor Coll. of Medicine, USA; Trial, J., Veterans Administration Medical Center, UNited States; Kessler, P. D., Johns Hopkins Medical Institutions, USA; Byrne, B. J., Florida Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 327-328; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A decrease in red cell mass (RBCM) has been an invariable occurrence following spaceflight that lasts more than 24 hours. Previous studies have indicated this decrease begins within the first day in microgravity because of the elimination of young circulating red cells or neocytolysis. This process of RBCM modulation had not been previously recognized and its exact mechanism has not been thoroughly investigated. Initially, to more clearly define this process, we have developed methods to separate red cells of various ages and have defined suitable markers to monitor the presence, absence or quantitative variation within this population of red cells. This is the first phase of the overall project to study a ground based model of neocytolysis.
Author
Circulation; Erythrocytes; Mass; Monitors

20000020571 Texas Univ., Dental Branch, Houston, TX USA
Regulation of Epidermal Growth Factor by Gravity
Durban, Elisa M., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 331-333; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Epidermal growth factor (EGF) is synthesized in a variety of tissues as a large membrane-bound precursor protein (approximately 130 kDa) from which mature EGF (6 kDa) and other EGF-like polypeptides are produced by proteolytic cleavage. Measurable levels of EGF are also found in many body fluids including plasma, saliva, urine, prostatic and seminal fluid, sweat, tears, gastric juice, and amniotic fluid. EGF is a principal regulator of proliferation and differentiation in development and throughout life. Documented in vivo functions of EGF include a role in maintaining gastric and oral mucosal integrity and cytoprotection, stimulating epidermal wound healing and renal tissue repair, regulating local bone formation by stimulating bone resorption, and modulating fluid balance and nervous system functions. Additionally EGF influences reproduction by stimulating the meiotic phase of spermatogenesis, enhancing maturation of oocytes, and participating in pregnancy-induced mammary gland development and lactation. This broad range of physiological functions is induced by binding of EGF to the EGF receptor, an integral membrane glycoprotein (170 kDa) with tyrosine kinase activity that is stimulated by EGF binding. The physiological role of EGF in normal cell function is strengthened by the presence of EGF receptors in virtually every cell in the body. The importance of EGF in human physiology also is highlighted by successful EGF therapy in patients requiring skin grafting, wound management or grastroduodenal ulcer treatment. Conceivably, subtle alterations in the regulation of the EGF biosynthetic/secretory pathway

in various tissues could affect a variety of physiological processes, therefore the effects of gravitational changes on EGF production were examined.
Author
Epidermis; Gravitation; Bones; Membranes; Proteins; Regulators; Growth; Nervous System; Physiological Effects; Stimulation

20000020574 Baylor Coll. of Medicine, Houston, TX USA
The Effect of Anti-Orthostatic Suspension on Delayed-Type Hypersensitivity Reactions
Kanwar, Samina, Baylor Coll. of Medicine, USA; Smolen, James E., Baylor Coll. of Medicine, USA; Smith, C. Wayne, Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999; 2p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The anti-orthostatic rodent model is an established ground-based model of simulated space flight. It has been reported that this model induces many physiological changes consistent with those observed in humans and animals during actual space flight. These include changes in stress hormone levels, over-use of upper and under-use of lower extremities and a cephalad fluid shift. To date there is limited evidence to suggest that these physiological changes affect the process of inflammation. Therefore, we propose to systematically study whether anti-orthostatic suspension (AOS) and the associated physiological changes directly influence basic inflammatory mechanisms. We will determine whether AOS induces tissue dysfunction and alters leukocyte infiltration, which is a hallmark feature of inflammation, during acute, non- specific inflammation and/or chronic, antigen-specific inflammation. We anticipate that any changes in leukocyte recruitment induced by AOS will significantly contribute to the development and/or resolution of inflammation.
Author
Orthostatic Tolerance; Models; Physiological Responses; Space Flight; Leukocytes; Infiltration

20000020578 Rochester Univ., NY USA
Health Hazards in Closed Environments: Thermodegradation of Wire Insulation
Oberdoerster, G., Rochester Univ., USA; Finkelstein, J. N., Rochester Univ., USA; Gelein, R., Rochester Univ., USA; Mercer, P., Rochester Univ., USA; Corson, N., Rochester Univ., USA; Johnston, C. J., Rochester Univ., USA; Weiss, B., Rochester Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 343-344; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Thermodegradation events during manned space missions can give rise to fumes originating from overheating of wire insulation. The high toxicity of such fumes is well known from accidental exposures resulting in symptoms summarized under the term "polymer fume fever." We have studied the composition and toxicity of fumes generated by heating of polytetrafluoroethylene (Teflon(R)), which is a frequently used component of insulation material. We have characterized the particulate phase of the fumes as consisting of extremely fine particles with count median diameters of - 1 5-25 nm (ultrafine particles), We hypothesize that these ultrafine particles are the major cause for the extremely high toxicity of PTFE fumes since particles in this range have a very high deposition efficiency throughout the lower respiratory tract, higher than for any other particle size, and they also penetrate rapidly across the epithelium to interstitial and vascular compartments. The objectives of our studies were to determine: (1) the role of the ultrafine Teflon(R) fume particles for causing toxicity; (2) the impact of Teflon(R) fume exposure on work performance; and (3) the effect of repeated exposures.
Author
Health; Hazards; Wire; Toxicity; Polytetrafluoroethylene; Insulation; Exposure

20000020582 NASA Johnson Space Center, Houston, TX USA
Study Design to Test the Hypothesis That Long-Term Space Travel Harms the Human and Animal Immune Systems
Shearer, William T., Baylor Coll. of Medicine, USA; Lugg, Desmond J., Australian Antarctic Div., Australia; Ochs, H. D., Washington Univ., USA; Pierson, Duane L., NASA Johnson Space Center, USA; Reuben, James M., M. D. Anderson Cancer Center, USA; Rosenblatt, Howard M., Baylor Coll. of Medicine, USA; Sams, Clarence, NASA Johnson Space Center, USA; Smith, C. Wayne, Baylor Coll. of Medicine, USA; Smith, E. Obrian, Baylor Coll. of Medicine, USA; Smolen, James E., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 351-353; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The potential threat of immunosuppression and abnormal inflammatory responses in long-term space travel, leading to unusual predilection for opportunistic infections, malignancy, and death, is of ma or concern to the National Aeronautics and Space Administration (NASA) Program. This application has been devised to seek answers to questions of altered immunity in space travel raised by previous investigations spanning 30-plus years. We propose to do this with the help of knowledge gained by the discovery of the molecular basis of many primary and secondary immunodeficiency diseases and by application of

molecular and genetic technology not previously available. Two areas of immunity that previously received little attention in space travel research will be emphasized: specific antibody responses and non-specific inflammation and adhesion. Both of these areas of research will not only add to the growing body of information on the potential effects of space travel on the immune system, but be able to delineate any functional alterations in systems important for antigen presentation, specific immune memory, and cell:cell and cell:endothelium interactions. by more precisely defining molecular dysfunction of components of the immune system, it is hoped that targeted methods of prevention of immune damage in space could be devised.
Author
Design Analysis; Physiological Responses; Infectious Diseases; Immune Systems; Hypotheses; Genetics; Damage

20000020583 Morehouse School of Medicine, Atlanta, GA USA
Update on the Effects of Space Flight on Development of Immune Responses
Sonnenfeld, G., Morehouse School of Medicine, USA; Foster, M., Carolinas Medical Center, USA; Morton, D., Carolinas Medical Center, USA; Bailliard, F., Carolinas Medical Center, USA; Fowler, N. A., Carolinas Medical Center, USA; Hakenwewerth, A. M., Carolinas Medical Center, USA; Bates, R., Texas Technological Univ., USA; Miller, E. S., Carolinas Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 354-355; In English
Contract(s)/Grant(s): NCC2-859; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study has been completed, and the following is an update of the results as published. Pregnant rats were flown on the Space Shuttle in the NIH.R I mission for 11 days, and pregnant control rats were maintained in animal enclosure modules in a ground-based chamber under conditions approximating those in flight. Additional controls were in standard housing. The effects of the flight on immunological parameters (including blastogenesis, interferon-gamma production, response to colony stimulating factor and total immunoglobulin levels) of dams, fetuses, and pups was determined.
Author
Immunology; Rats; Physiological Responses; Immunity; Weightlessness

20000020586 NASA Johnson Space Center, Houston, TX USA
Muscle Session Summary
Baldwin, Kenneth, California Univ., USA; Feeback, Daniel, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 359-362; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Presentations from the assembled group of investigators involved in specific research projeects related to skeletal muscle in space flight can categorized in thematic subtopics: regulation of contractile protein phenotypes, muscle growth and atrophy, muscle structure: injury, recovery,and regeneration, metabolism and fatigue, and motor control and loading factors.
Derived from text
Musculoskeletal System; Proteins; Pharmacology; Nerves; Microgravity; Gravitation

20000020589 California Univ., Los Angeles, CA USA
Effects of Microgravity on the Accuracy of Elbow and Ankle Flexor and Extensor Motor Pools in Maintaining a Target Torque
Edgerton, V. R., California Univ., USA; McCall, G. E., California Univ., USA; Fleischman, K. O., California Univ., USA; Boorman, G. I., California Univ., USA; Goulet, C., California Univ., USA; Roy, R. R., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 369; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The microgravity environment significantly alters proprioceptive inputs to the spinal cord motor pools. However, the means for accommodating those changes so that movements can be controlled in microgravity, and further adapt to this new environment, has received little attention. We hypothesized that the neural control to the motor pools of antigravity (primary extensor) muscles would be affected more by alterations of sensory systems influenced by gravitational forces than the motor pools of non-antigravity (primary flexor) muscles. to test this hypothesis, the effects of a 17-day spaceflight on the ability to maintain constant torque output at the elbow or ankle joint were studied.
Author
Microgravity; Flexors; Hypotheses; Muscles

20000020590 Baylor Coll. of Medicine, Houston, TX USA

Molecular Signaling in Muscle Plasticity

Epstein, H. F., Baylor Coll. of Medicine, USA; Gordon, S., Texas Univ. Health Science Center, USA; Booth, F. W., Texas Univ. Health Science Center, USA; Rajadurai, H., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 370; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Extended spaceflight under microgravity conditions leads to significant atrophy of weight-bearing muscles. Atrophy and hypertrophy are the extreme outcomes of the high degree of plasticity exhibited by skeletal muscle. Stimuli which control muscle plasticity include neuronal, hormonal, nutritional, and mechanical inputs. The mechanical stimulus for muscle is directly related to the work or exercise against a load performed. Little or no work is performed by weight-bearing muscles under microgravity conditions. A major hypothesis is that focal adhesion kinase (FAK) which is associated with integrin at the adherens junctions and costameres of all skeletal muscles is an integral part of the major mechanism for molecular signaling upon mechanical stimulation in all muscle fibers. Additionally, we propose that myotonic protein kinase (DMPK) and dystrophin (DYSTR) also participate in distinct mechanically-stimulated molecular signaling pathways that are most critical in type I and type II muscle fibers, respectively. to test these hypotheses, we will use the paradigms of hindlimb unloading and overloading in mice as models for microgravity conditions and a potential exercise countermeasure, respectively, in mice. We expect that FAK loss-of-function will impair hypertrophy and enhance atrophy in all skeletal muscle fibers whereas DYSTR and DMPK loss-of-function will have similar but more selective effects on Type II and Type I fibers, respectively. Gene expression will be monitored by muscle-specific creatine kinase M promoter-reporter construct activity and specific MRNA and protein accumulation in the soleus (type I primarily) and plantaris (type II primarily) muscles. With these paradigms and assays, the following Specific Project Aims will be tested in genetically altered mice: 1) identify the roles of DYSTR and its pathway; 2) evaluate the roles of the DMPK and its pathway; 3) characterize the roles of FAK and its pathway and 4) genetically analyze the mechanisms and interactions between the FAK, DYSTR, and DMPK-associated pathways in single and specific combinations of mutants. The identification of potential signaling mechanisms may permit future development of pharmacological countermeasures for amelioration and prevention of the microgravity- induced atrophy in extended spaceflight, and the analysis of both overloading and unloading paradigms may provide further support for development of exercise-based countermeasures. Understanding the basic mechanisms of molecular signaling in muscle plasticity may aid our understanding and treatment of skeletal muscle atrophy not only in spaceflight but in similar problems of the aging population, in prolonged bed rest, and in cachexia associated with chronic disease.

Author

Atrophy; Bed Rest; Countermeasures; Gene Expression; Loads (Forces); Losses; Microgravity; Musculoskeletal System; Neurophysiology; Physical Exercise

20000020591 Marquette Univ., Milwaukee, WI USA

Alterations in Skeletal Muscle Function with Microgravity, and the Protective Effects of High Resistance Isometric and Isotonic Exercise

Fitts, R. H., Marquette Univ., USA; Hurst, J. E., Marquette Univ., USA; Norenberg, K. M., Marquette Univ., USA; Widrick, J. J., Marquette Univ., USA; Riley, D. A., Marquette Univ., USA; Bain, J. L. W., Marquette Univ., USA; Trappe, S. W., Marquette Univ., USA; Trappe, T. A., Marquette Univ., USA; Costill, D. L., Marquette Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 371-373; In English

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Exposure to microgravity or models designed to mimic the unloaded condition, such as bed rest in humans and hindlimb unloading (HU) in rats leads to skeletal muscle atrophy, a loss in peak force and power, and an increased susceptibility to fatigue. The posterior compartment muscles of the lower leg (calf muscle group) appear to be particularly susceptible. Following only 1 wk in space or HU, rat soleus muscle showed a 30 to 40% loss in wet weight. After 3 wk of HU, almost all of the atrophied soleus fibers showed a significant increase in maximal shortening velocity (V(sub 0)), while only 25 to 30 % actually transitioned to fast fibers. The increased V(sub 0), was protective in that it reduced the decline in peak power associated with the reduced peak force. When the soleus is stimulated in situ following HU or zero-g one observes an increased rate and extent of fatigue, and in the former the increased fatigue is associated with a more rapid depletion of muscle glycogen and lactate production. Our working hypothesis is that following HU or spaceflight in rats and bed rest or spaceflight in humans limb skeletal muscles during contractile activity depend more on carbohydrates and less on fatty acids for their substrate supply. Baldwin et al. found 9 days of spaceflight to reduce by 37% the ability of both the high and low oxidative regions of the vastus muscle to oxidize long-chain fatty acids. This decline was not associated with any change in the enzymes of the tricarboxylic acid cycle or oxidation pathway. The purpose of the current research was to establish the extent of functional change in the slow type I and fast type H fibers of the human calf muscle following 17 days of spaceflight, and determine the cellular mechanisms of the observed changes. A second goal was to study the

effectiveness of high resistance isotonic and isometric exercise in preventing the deleterious functional changes associated with unloading.
Author
Musculoskeletal System; Microgravity; Physical Exercise; Muscular Function; Losses; Lactates; Isotonicity

20000020592 NASA Johnson Space Center, Houston, TX USA
In Vivo Noninvasive Analysis of Human Forearm Muscle Function and Fatigue: Applications to EVA Operations and Training Maneuvers
Fotedar, L. K., National Academy of Sciences - National Research Council, USA; Marshburn, T., NASA Johnson Space Center, USA; Quast, M. J., Texas Univ., USA; Feeback, D. L., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 374-375; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Forearm muscle fatigue is one of the major limiting factors affecting endurance during performance of deep-space extravehicular activity (EVA) by crew members. Magnetic resonance (MR) provides in vivo noninvasive analysis of tissue level metabolism and fluid exchange dynamics in exercised forearm muscles through the monitoring of proton magnetic resonance imaging (MRI) and phosphorus magnetic resonance spectroscopy (P-31-MRS) parameter variations. Using a space glove box and EVA simulation protocols, we conducted a preliminary MRS/MRI study in a small group of human test subjects during submaximal exercise and recovery and following exhaustive exercise. In assessing simulated EVA-related muscle fatigue and function, this pilot study revealed substantial changes in the MR image longitudinal relaxation times (T2) as an indicator of specific muscle activation and proton flux as well as changes in spectral phosphocreatine-to-phosphate (PCr/Pi) levels as a function of tissue bioenergetic potential.
Author
Magnetic Resonance; Human Beings; Imaging Techniques; Fatigue (Biology); Simulation; Physical Exercise; Muscular Function; Forearm; Exhausting

20000020593 Harvard Medical School, Dept. of Cell Biology, Boston, MA USA
Activation of the Ubiquitin-Proteasome Pathway in Atrophying Muscles and Potential Inhibitors
Goldberg, A. L., Harvard Medical School, USA; Lee, D. H., Harvard Medical School, USA; Solomon, V., Harvard Medical School, USA; Lecker, S., Harvard Medical School, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 376; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Many observations indicate that the rapid loss of muscle mass with denervation atrophy, hind- limb suspension, cancer cachexia, sepsis, and hyperthyroidism is primarily due to enhanced protein breakdown via the ubiquitin-proteasome pathway. This proteolytic system is responsible for most protein degradation in extracts of skeletal muscle. Also, inhibitors of the proteasome, such as MG 132, can selectively reduce the enhanced proteolysis in atrophying muscles during in vitro incubation. While such inhibitors have potential in the prevention of muscle wasting, the "therapeutic window" is narrow, and they can induce apoptosis at high concentrations. Interestingly, our recent studies of the effects of proteasome inhibitors indicate that concentrations that inhibit protein breakdown also cause induction of heat-shock proteins and thus enhance cell resistance to high temperatures and free radical damage. We have also attempted to identify more selective sites in this pathway for inhibition. One property of a protein which leads to its rapid ubiquitination is the presence of a bulky hydrophobic or charged N-terminal residue, but natural substrates of this "N-end rule" pathway have not been identified. Surprisingly, we found that this pathway, which involves E2-14K and E3(x, catalyzes degradation of most soluble proteins in muscle extracts. Moreover, we showed that in many catabolic states, where muscle proteolysis rises, rates of protein ubiquitination increase, due mainly to activation of the "N-end rule" pathway. In extracts of atrophying rat leg muscles from tumor-bearing, hyperthyroid and hind-limb suspended animals, ubiquitin conjugation to soluble proteins increases, and inhibitors of the E3(alpha) suppress most of the enhanced ubiquitination. Furthermore, ubiquitination of lysozyme, a typical "N-end rule" substrate, increases in these atrophying muscles. Thus, overall rates of ubiquitination vary under different conditions, and activation of the "N-end rule" pathway is a major contributor to the accelerated proteolysis in atrophying muscles.
Author
Musculoskeletal System; Proteins; Lysozyme; Losses; Degradation; Damage; Catabolism; Cancer; Atrophy

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Space Physiology Studies

Hargens, A. R., NASA Ames Research Center, USA; Ballard, R. E., California Univ., USA; Boda, W. L., Sonoma State Univ., USA; Ertl, A. C., Vanderbilt Univ., USA; Schneider, S. M., NASA Johnson Space Center, USA; Hutchinson, K. J., California Univ., USA; Lee, S. M., NASA Johnson Space Center, USA; Murthy, G., California Univ., USA; Putcha, L., NASA Johnson Space Center, USA; Watenpaugh, D. E., University of North Texas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 378-384; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Calculations suggest that exercise in space to date has lacked sufficient loads to maintain musculoskeletal mass. Lower body negative pressure (LBNP) produces a force at the feet equal to the product of the LBNP and body cross-sectional area at the waist. Supine exercise within 50-60 mm Hg LBNP improves tolerance to LBNP and produces forces similar to those occurring during upright posture on Earth. Thus, exercise within LBNP may help prevent deconditioning of astronauts by stressing tissues of the lower body in a manner similar to gravity and also, may provide a safe and effective alternative to centrifugation in terms of cost, mass, volume, and power usage. We hypothesize that supine treadmill exercise during LBNP at one body weight (50-60 mm Hg LBNP) will provide cardiovascular and musculoskeletal loads similar to those experienced while upright in lg. Also, daily supine treadmill running in a LBNP chamber will maintain aerobic fitness, orthostatic tolerance, and musculoskeletal structure and function during bed rest (simulated microgravity).

Author

Physiological Tests; Aerobes; Cardiovascular System; Deconditioning; Gravitation; Lower Body Negative Pressure; Musculoskeletal System; Physical Exercise

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Muscle Deoxygenation Causes Muscle Fatigue

Murthy, G., California Univ., USA; Hargens, A. R., NASA Ames Research Center, USA; Lehman, S., California Univ., USA; Rempel, D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 390-392; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Muscle fatigue is a common musculoskeletal disorder in the work place, and may be a harbinger for more disabling cumulative trauma disorders. Although the cause of fatigue is multifactorial, reduced blood flow and muscle oxygenation may be the primary factor in causing muscle fatigue during low intensity muscle exertion. Muscle fatigue is defined as a reduction in muscle force production, and also occurs among astronauts who are subjected to postural constraints while performing lengthy, repetitive tasks. The objectives of this research are to: 1) develop an objective tool to study the role of decreased muscle oxygenation on muscle force production, and 2) to evaluate muscle fatigue during prolonged glovebox work.

Author

Musculoskeletal System; Oxygenation; Fatigue (Biology)

20000020600 Massachusetts General Hospital, Cardiovascular Research Center, Boston, MA USA

E Proteins Control Skeletal Muscle Fiber Type

Neville, Craig, Massachusetts General Hospital, USA; Gonzales, Donald, Massachusetts General Hospital, USA; Purdy, Joy, Massachusetts General Hospital, USA; Zuang, Yuan, Duke Univ., USA; Rosenthal, Nadia, Massachusetts General Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 393-394; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Vertebrate skeletal muscle development involves the fusion of undifferentiated mononucleated myoblasts to form multinucleated myofibers, with a concomitant activation of muscle-specific genes encoding proteins that form the contractile apparatus. The regulatory circuit controlling skeletal muscle gene expression has been well studied in a number of vertebrate animal systems, and has resulted in a rather extensive understanding regarding muscle formation during embryonic development. In contrast, the molecular mechanisms underlying the further specification of muscle cells into different fiber types is poorly understood. We have investigated the role of a family of transcriptional proteins, known as E proteins, as the genetic basis of fiber specificity. The aims of this project are to define the mechanisms, and the potential importance of E proteins, responsible for the shifts in fiber type under conditions of microgravity.

Author

Proteins; Musculoskeletal System; Fibers; Vertebrates; Cells (Biology)

20000020601 Wisconsin Univ., Dept. of Anatomy, Madison, WI USA

Weightlessness Reduces Skeletal Muscle Growth and Regeneration Potential

Schultz, E., Wisconsin Univ., USA; Mozdziak, P. E., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 395-396; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Myonuclear increase is required for myofiber enlargement during skeletal muscle growth and is solely dependent upon the proliferation of satellite cells and the fusion of their progeny with the enlarging myofibers. Likewise, regeneration of injured skeletal muscles is dependent upon the proliferation of satellite cells to produce a sufficient supply of myogenic cells for the formation of replacement myofibers and for the subsequent growth of these myofibers.

Author

Weightlessness; Musculoskeletal System; Progeny

20000020604 NASA Ames Research Center, Moffett Field, CA USA

Neurovestibular Session Summary

Oman, Charles, Massachusetts Inst. of Tech., USA; Cohen, Malcolm, NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 403-406; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Oman - The early mission operational problems caused by space motion sickness have been largely resolved in recent years. This has been achieved by appropriate timeline adjustments, voluntary head movement restriction, and judicious use of promethazine. Crew members now simply accept that some symptoms "come with the job," and usually last only a few days. But as more people have flown longer flights, we've seen cases of space sickness and inversion illusion that take several weeks to resolve. Visual reorientation illusions continue throughout long flights, and occasionally cause difficulties. EVA astronauts sometimes suddenly fear they will fall out of the payload bay or off of the RMS or Strella arms. Orientation and navigation in three dimensions in the MIR station reportedly does not come naturally, because modules have different visual verticals. It is clear that the neurovestibular problems of spaceflight have not disappeared. After return to Earth, many crew members are disoriented and ataxic in the first hour after return, and require assistance leaving the vehicle, Flight surgeons say that the longer the mission, the stronger the aftereffects, certain of which last for weeks. We do not yet know how to predict who will be afflicted. Looking ahead to 3-4 month long voyages to Mars, it seems obvious that if cruise is in O-G, the crew may encounter neurovestibular problems on arrival. Artificial G may be broadly effective as a countermeasure for many of the physiological changes of spaceflight, but from the neurovestibular perspective, it is a double-edged sword. We know that the Coriolis stimulus resulting from rotation is potentially disorienting and nauseogenic. But we don't yet know how much artificial G will be enough, nor how successfully people can adapt to a specific angular velocity and hypo G level. Development of countermeasures remains a big challenge for our neurovestibular community. Maintaining an interdisciplinary perspective is important. Three examples were presented at this meeting: 1) Transgenic animal experiments suggest that in addition to the light illumination cycle, vestibular inputs may also serve as an important input to the circadian system. 2) Radiation can cause important CNS effects in animals, including loss of spatial memory. 3) As described in our session, otolith inputs may contribute to cardiovascular regulation of orthostatic tolerance. Over the past three days, we've all enjoyed catching up with old friends, and making many new ones. On behalf of my colleagues, I want to thank Al Coats and the USRA DSLS staff for the great job they did in running this meeting. and keeping the emphasis on fun. and also my Co- Chair, Mal Cohen, who had more stamina than many of us, despite major surgery only three weeks ago. Mal and I have written a few lines describing each of the seventeen papers in our session, to give you a quick over-view, and as a guide to the full abstracts, We have grouped them under five themes: preflight and inflight countermeasurements, postlanding posture and locomotion deficits: assessment and prediction, adaptive processes, relationships among physical simuli, perceptions, and eye movements, vestibular contribution to human autonomic responses, and implications and recommendations.

Author

Angular Velocity; Cardiovascular System; Central Nervous System; Countermeasures; Extravehicular Activity; Head Movement; Oman; Space Adaptation Syndrome

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Visually-Induced Adaptation in Gravity-Sensitive Properties of Primate Vestibulo-Ocular Reflex

Angelaki, Dora E., Mississippi Univ. Medical Center, USA; Hess, B. J. M., Zurich Univ., Switzerland; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 407-408; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Most natural head movements, particularly those including pitch and roll movements, involve dynamic changes in the orientation relative to gravity. In addition to the semicircular canals, these head movements also activate the otolith system. Even though the adaptive ability of the semicircular canal-activated aspects of the vestibulo-ocular reflex (VOR) have been repeatedly

demonstrated, very little is currently known about the adaptive processes underlying the gravity- related aspects of the VOR. The present studies aimed at addressing this issue.
Author
Vestibules; Head Movement; Otolith Organs; Semicircular Canals; Sensitivity

20000020607 NASA Johnson Space Center, Houston, TX USA
The Effects of Long-Duration Spaceflight on Postflight Terrestrial Locomotion
Bloomberg, J. J., NASA Johnson Space Center, USA; Mulavara, A. P., Wyle Life Sciences, Inc., USA; McDonald, P. V., Wyle Life Sciences, Inc., USA; Layne, C. S., Houston Univ., USA; Merkle, L. A., NASA Johnson Space Center, USA; Cohen, H. S., Baylor Coll. of Medicine, USA; Kozlovskaya, I. B., Institute for Biomedical Problems, Russia; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 411-412; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Locomotion is a complex task requiring the coordinated integration of multiple sensorimotor subsystems. This coordination is exemplified by the precise control of segmental kinematics that allows smooth progression of movement in the face of changing environmental constraints. Exposure to the microgravity environment encountered during space flight induces adaptive modification in the central processing of sensory input to produce motor responses appropriate for the prevailing environment. This inflight adaptive change in sensorimotor function is inappropriate for movement control in 1-g and leads to postflight disturbances in terrestrial locomotor function. We have previously explored the effects of short-duration (7-16 days) space flight on the control of locomotion. The goal of the present set of studies was to investigate the effects of long-duration spaceflight (3-6 months) on the control of locomotion with particular emphasis on understanding how the multiple interacting systems are adaptively modified by prolonged microgravity exposure.
Author
Locomotion; Microgravity; Exposure

20000020608 Brandeis Univ., Ashton Graybiel Spatial Orientation Lab., Waltham, MA USA
Motor Control and Adaptation in a Rotating Artificial Gravity Environment
DiZio, P., Brandeis Univ., USA; Lackner, J. R., Brandeis Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 413-415; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One obstacle to the idea of rotating a space vehicle to generate artificial gravity is concern about the side effects of rotation on human sensorimotor control. The most conspicuous side effects in a rotating room are the severely disorienting and nauseogenic consequences of head movements at high room speeds. In early experiments, adapting people to tolerate head movements at rotation rates greater than 3 rpm required great effort and resulted in powerful aftereffects upon return to a non-rotating environment. Generating 1 g of artificial gravity at 3 rpm requires a radius of about 100 meters, which is technically and financially unrealistic. Approaches to adapting humans to tolerate higher rates of rotation have focussed on vestibular mechanisms. We have investigated the effects of linear Coriolis forces generated in a rotating environment on voluntary arm and leg movements as well as on head movements and posture. The results indicate that adaptation up to 10 rpm can be achieved if exposure history is appropriately controlled.
Author
Artificial Gravity; Coriolis Effect; Head Movement; Rotating Bodies; Vestibules; Efferent Nervous Systems

20000020609 Mount Sinai School of Medicine, New York, NY USA
Sympathetic Efferent Activity is Driven by Otolith Stimulation
Kaufmann, H., Mount Sinai School of Medicine, USA; Biaggioni, I., Vanderbilt Univ., USA; Voustaniuk, A., Mount Sinai School of Medicine, USA; Diedrich, A., Vanderbilt Univ., USA; Costa, F., Vanderbilt Univ., USA; Clark, R., JFK Neuroscience Inst., USA; Gizzi, M., JFK Neuroscience Inst., USA; Cohen, B., Mount Sinai School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 416-417; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study was designed to test the hypothesis that stimulation of vestibular otolith organs in humans activates sympathetic outflow. A vestibular-autonomic reflex triggered by changes in posture or gravity has been postulated. This reflex produces changes in heart rate and vascular tone that are important in the maintenance of blood flow to the brain, particularly during orthostatic stress. In the vestibular apparatus, semicircular canals sense angular acceleration and otolith organs, sense translation and tilt of the head with regard to gravity, i.e., they are gravireceptors. Thus, otolith organs are the ones likely to trigger a reflex

mechanism that maintains cerebral blood flow against gravity during orthostasis. Accordingly, in this study we investigated whether selective stimulation of the otolith organs activates sympathetic efferent.
Author
Sympathetic Nervous System; Efferent Nervous Systems; Otolith Organs; Hypotheses; Vestibules; Brain Circulation

20000020610 NASA Johnson Space Center, Houston, TX USA
Anticipatory Postural Activity During Long-Duration Space Flight
Layne, C. S., Houston Univ., USA; Mulavara, A. P., Wyle Life Sciences, USA; McDonald, P. V., Nascent Technologies, USA; Pruett, C. J., TECMATH, USA; Koslovskaya, B., Institute of Biomedical Problems, USSR; Bloomberg, J. J., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 418-419; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Somatosensory input has been used to modify motor output in many contexts. During space flight, the use of the lower limb musculature is much less than during activities in 1g. Consequently the neuromuscular activity of the legs is also reduced during space flight. This decrease in muscle activity contributes to muscle atrophy. Furthermore, adaptations to weightlessness contribute to posture and locomotion problems upon the return to Earth. Providing techniques to counter the negative effects of weightlessness on the neuromuscular system is an important goal, particularly during a long-duration mission. Previous work by our group has shown that lower limb neuromuscular activation that normally precedes arm movements in 1g is absent or greatly reduced during similar movements made while freefloating. However, preliminary evidence indicates that applying pressure to the feet results in enhanced neuromuscular activation during rapid arm movements performed while freefloating. This finding suggests that sensory input can be used to "drive" the motor system to increase neuromuscular functioning throughout a mission. The purpose of this investigation was to quantify the increase in neuromuscular activation resulting from the application of pressure to the feet.
Author
Weightlessness; Sensory Perception; Muscular Function; Atrophy; Leg (Anatomy)

20000020611 California Univ., Santa Barbara, CA USA
Otolith-Ocular Torsion is Modified in Novel G States
Markham, Charles H., California Univ., USA; Diamond, Shirley G., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 420; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The inner ear otolith system responds to linear acceleration including gravity. Its main motor control function is stabilizing the neck, axial musculature and limbs to maintain posture. It also modulates ocular torsion, giving a window to view the otolith system in ways not possible in viewing the spinal reflexes. Otolith-ocular torsion, when examined binocularly, is especially sensitive to novel changes in G as observed during parabolic flight and in spaceflight. Under these conditions, life-long compensation to possible asymmetries in this bilateral system may become decompensated and at least four unusual responses may be seen: (1) Ocular torsional disconjugacy, increasing over increasing parabolas has allowed prediction of who has or has not had previous motion sickness. Use of this test by NASA could lead to better prophylactic treatment an exclusionary test) since it is known that most of the 60-70% who develop space motion sickness nevertheless perform well after the first 3-4 days of flight. (2) Changes in binocular ocular torsion in the 0 G and 1.8 G portions of parabolic flight reveal in most subjects a systematic reversal of direction. The reversal is consistent within subjects, but not across subjects. We suggest this phenomenon is due to the responsible hair cells being deflected first in one direction and then in the opposite direction. We do not know the location of the critical hair cells but plan appropriate experiments. (3) Parabolic flights in the Hyushin and Caravelle aircraft have 3-5 minutes of level 1 G between each parabola. Binocular torsion in most subjects becomes disconjugate and offset from pre-parabola values in the first parabola and this persists for the remainder of the flight. It is best seen in the intervals between parabolas. We suggest the abrupt G changes experienced in the first parabola causes otoconial displacement or other end organ instability. and (4) In one and six months spaceflights in three cosmonauts, ocular torsion was dis-conjugate and offset by several degrees compared to preflight reference values. On return to earth, torsional disconjugacy and offset persisted for weeks to months. Such long duration changes in the otolith-ocular reflex have unknown impact in humans during and after long-duration spaceflight.
Author
Otolith Organs; Ocular Circulation; Torsion; Cells (Biology); Conjugates; Displacement; Ear; Gravitation; Motion Sickness

20000020612 Nascent Technologies Ltd., Houston, TX USA

A Methodology for Investigating Adaptive Postural Control

McDonald, P. V., Nascent Technologies Ltd., USA; Riccio, G. E., Nascent Technologies Ltd., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 421-424; In English

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Our research on postural control and human-environment interactions provides an appropriate scientific foundation for understanding the skill of mass handling by astronauts in weightless conditions (e.g., extravehicular activity or EVA). We conducted an investigation of such skills in NASA's principal mass-handling simulator, the Precision Air-Bearing Floor, at the Johnson Space Center. We have studied skilled movement-body within a multidisciplinary context that draws on concepts and methods from biological and behavioral sciences (e.g., psychology, kinesiology and neurophysiology) as well as bioengineering. Our multidisciplinary research has led to the development of measures, for manual interactions between individuals and the substantial environment, that plausibly are observable by human sensory systems. We consider these methods to be the most important general contribution of our EVA investigation. We describe our perspective as control theoretic because it draws more on fundamental concepts about control systems in engineering than it does on working constructs from the subdisciplines of biomechanics and motor control in the bio-behavioral sciences. At the same time, we have attempted to identify the theoretical underpinnings of control-systems engineering that are most relevant to control by human beings. We believe that these underpinnings are implicit in the assumptions that cut across diverse methods in control-systems engineering, especially the various methods associated with "nonlinear control", "fuzzy control," and "adaptive control" in engineering. Our methods are based on these theoretical foundations rather than on the mathematical formalisms that are associated with particular methods in control-systems engineering. The most important aspects of the human-environment interaction in our investigation of mass handling are the functional consequences that body configuration and stability have for the pick up of information or the achievement of overt goals. It follows that an essential characteristic of postural behavior is the effective maintenance of the orientation and stability of the sensory and motor "platforms" (e.g., head or shoulders) over variations in the human, the environment and the task. This general skill suggests that individuals should be sensitive to the functional consequences of body configuration and stability. In other words, individuals should perceive the relation between configuration, stability, and performance so that they can adaptively control their interaction with the surroundings. Human-environment interactions constitute robust systems in that individuals can maintain the stability of such interactions over uncertainty about and variations in the dynamics of the interaction. Robust interactions allow individuals to adopt orientations and configurations that are not optimal with respect to purely energetic criteria. Individuals can tolerate variation in postural states, and such variation can serve an important function in adaptive systems. Postural variability generates stimulation which is "textured" by the dynamics of the human-environment system. The texture or structure in stimulation provides information about variation in dynamics, and such information can be sufficient to guide adaption in control strategies. Our method were designed to measure informative patterns of movement variability.

Derived from text

Pattern Method (Forecasting); Adaptive Control; Posture; Extravehicular Activity; Multidisciplinary Research; Neurophysiology; Observation; Weightlessness

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Low-Frequency Otolith Function in Microgravity: A Re-Evaluation of the Otolith Tilt-Translation Reinterpretation (OTTR) Hypothesis

Moore, Steven T., Mount Sinai School of Medicine, USA; Cohen, Bernard, Mount Sinai School of Medicine, USA; Clement, Gilles, Centre National de la Recherche Scientifique, France; Raphan, Theodore, State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 425-428; In English

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On Earth, the low-frequency afferent signal from the otoliths encodes head tilt with respect to the gravitational vertical, and the higher frequency components reflect both tilt and linear acceleration of the head. In microgravity, static tilt of the head does not influence otolith output, and the relationship between sensory input from the vestibular organs, and the visual, proprioceptive and somatosensory systems, would be disrupted. Several researchers have proposed that in 0-g this conflict may induce a reinterpretation of all otolith signals by the brain to encode only linear translation (otolith tilt-translation reinterpretation or OTTR). Ocular counter-rolling (OCR) is a low-frequency otolith-mediated reflex, which generates compensatory torsional eye movements (rotation about the visual axis) towards the spatial vertical during static roll tilt with a gain of approximately 10%. Transient linear acceleration and off-axis centrifugation at a constant angular velocity can also generate OCR. According to the OTTR hypothesis, OCR should be reduced in microgravity, and immediately upon return from a 0-g environment. Results to date have been inconclusive. OCR was reduced following the 10 day Spacelab-1 mission in response to leftward roll tilts (28-56% in

3 subjects and unchanged in one subject), and sinusoidal linear oscillations at 0.4 and 0.8 Hz. OCR gain declined 70% in four monkeys following a 14 day COSMOS mission. Following a 30 day MIR mission OCR gain decreased in one astronaut, but increased in two others following a 180 day mission. We have studied the affect of microgravity on low-frequency otolith function as part of a larger study of the interaction of vision and the vestibular system. This experiment (E-047) involved off-axis centrifugation of payload crewmembers and flew aboard the recent Neurolab mission (STS 90). Presented below are preliminary results focusing on perception and the OCR response during both centrifugation and static tilt.
Author
Low Frequencies; Otolith Organs; Microgravity; Evaluation; Hypotheses; Vestibules

20000020614 Massachusetts Inst. of Tech., Man Vehicle Lab., Cambridge, MA USA
Human Visual Orientation in Unfamiliar Gravito-Inertial Environments
Oman, C., Massachusetts Inst. of Tech., USA; Howard, I., York Univ., Canada; Shebilske, W., Texas A&M Univ., USA; Taube, J., Dartmouth Coll., USA; Beall, A., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 429-431; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The vestibular, visual, tactile, and proprioceptive senses provide the essential cues necessary for spatial orientation and sensory-motor coordination both on Earth and in weightlessness. Space motion sickness associated with neurovestibular adaptation affects early in-flight performance of astronauts arguably more than any other physiological change. Post-flight neurovestibular problems, including earth sickness, disorientation and locomotor ataxia increase in severity with flight duration. In the fall of 1997, the National Space Biomedical Institute Neurovestibular Adaptation Team initiated three projects to help define the mechanisms, and to develop improved neurovestibular countermeasures for use in NASA's Space Station and future Planetary exploration programs. These include the present multi-investigator, inter-institutional project on human visual orientation, and also two other projects presented at this meeting (Shelhamer, et al's study of context-specific adaptation of gravity-dependent reflex responses; Wall, et al's investigation of locomotor ataxia, spatial orientation, and gaze stability). The objective of the Visual Orientation project is to better understand the process of spatial orientation and navigation in unfamiliar gravito-inertial environments, and to use this information to develop effective countermeasures against the orientation and navigation problems experienced by astronauts.
Derived from text
Visual Stimuli; Orientation; Adaptation; Astronauts; Coordination; Countermeasures; Gravitational Effects; Weightlessness; Vestibules

20000020615 NASA Johnson Space Center, Houston, TX USA
Mechanisms of Sensorimotor Adaptation to Centrifugation
Paloski, W. H., NASA Johnson Space Center, USA; Wood, S. J., National Space Biomedical Research Inst., USA; Kaufman, G. D., National Academy of Sciences - National Research Council, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 432-434; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We postulate that centripetal acceleration induced by centrifugation can be used as an inflight sensorimotor countermeasure to retain and/or promote appropriate crewmember responses to sustained changes in gravito-inertial force conditions. Active voluntary motion is required to promote vestibular system conditioning, and both visual and graviceptor sensory feedback are critical for evaluating internal representations of spatial orientation. The goal of our investigation is to use centrifugation to develop an analog to the conflicting visual/gravito-inertial force environment experienced during space flight, and to use voluntary head movements during centrifugation to study mechanisms of adaptation to altered gravity environments. We address the following two hypotheses: (1) Discordant canal-otolith feedback during head movements in a hypergravity tilted environment will cause a reorganization of the spatial processing required for multisensory integration and motor control, resulting in decreased postural stability upon return to normal gravity environment. (2) Adaptation to this "gravito-inertial tilt distortion" will result in a negative after-effect, and readaptation will be expressed by return of postural stability to baseline conditions. During the third year of our grant we concentrated on examining changes in balance control following 90-180 min of centrifugation at 1.4 9. We also began a control study in which we exposed subjects to 90 min of sustained roll tilt in a static (non-rotating) chair. This allowed us to examine adaptation to roll tilt without the hypergravity induced by centrifugation. To these ends, we addressed the question: Is gravity an internal calibration reference for postural control? The remainder of this report is limited to presenting preliminary findings from this study.
Author
Adaptation; Centrifuging; Countermeasures; Feedback; Gravireceptors; Head Movement; Otolith Organs; Sensory Feedback; Vestibules

20000020619 Massachusetts General Hospital, Biomotion Lab., Boston, MA USA

Application of Floquet Stability Analysis to Repeated Stepping in LD and Normal Subjects

Wall, Conrad, III, Massachusetts General Hospital, USA; Krebs, David E., Massachusetts General Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 447-448; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One aim of this work is to characterize the dynamics of locomotion stability in response to perturbations of the Body Segment Variables. This report concerns the application of Floquet multipliers to analyze the stability of normal and labyrinthine deficient (LD) subjects. At the Massachusetts General Hospital Biomotion Laboratory, a preliminary analysis of a stair stepping experiments done on 24 subjects.

Author

Locomotion; Dynamic Characteristics; Stability Tests; Experimentation

20000020620 NASA Ames Research Center, Moffett Field, CA USA

Vision and Visual-Motor Coordination in Pitched Visual Environments

Welch, Robert B., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 449-450; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The everyday perception of one's bodily orientation is determined by two classes of sensory cues: Vision and gravity. Because these cues typically agree, as when one is standing in a lighted room, it is difficult if not impossible to determine the degree to which each contributes to spatial perception. Therefore, in order to make this judgment it is necessary to introduce a conflict between vision and gravity and note the resulting perceptual experience. One simple way to do this is to expose the observer to a visual framework that has been rolled or pitched relative to the gravitational vector. The underlying assumption is that the separate contributions of vision and gravity to the perception of bodily orientation that are measured in such a situation of intersensory conflict are the same as those that operate under normal (i.e., non-conflicting) circumstances.

Derived from text

Visual Perception; Orientation; Cues; Motion

20000020622 Texas Univ., Medical Branch, Galveston, TX USA

The Combined Effects of Inactivity and Cortisol on Muscle Protein Metabolism

Ferrando, Arny A., Texas Univ., USA; Stuart, Charles S., Texas Univ., USA; Wolfe, Robert R., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 455; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We have previously noted that inactivity results in a loss of lean body mass (LBM) due to reduced protein synthesis. We have also shown that severely burned patients lose lean body mass due to an increase in net protein breakdown. Severe burn injury is also associated with an increased cortisol secretion, whereas inactivity does not alter this hormonal profile. Thus, we tested the hypothesis that inactivity exacerbates the catabolic effects of cortisol on skeletal muscle protein.

Author

Cortisone; Catabolism; Protein Metabolism; Muscles

20000020623 Wake Forest Univ., Dept. of Urology, Winston-Salem, NC USA

Dietary Oxalate and its Influence on Urinary Oxalate Excretion

Holmes, Ross P., Wake Forest Univ., USA; Assimos, Dean G., Wake Forest Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 456-458; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One in eight white Caucasian males will form a calcium oxalate kidney stone at some point in their lifetime and up to one in three may be genetically susceptible to forming one. As physiological changes during space flight increase stone risk factors the formation of a kidney stone during extended space flight becomes a distinct possibility. Effective countermeasures are required to offset this stone risk. We have investigated the contribution of dietary oxalate to stone risk as gauged by changes in urinary oxalate excretion as this risk factor has the potential to be modified.

Author

Oxalates; Diets; Urology; Excretion; Calcium

20000020626 NASA Johnson Space Center, Houston, TX USA

Salivary Pharmacodynamics and Bioavailability of Promethazine in Human Subjects

Putcha, Lakshmi, NASA Johnson Space Center, USA; Harm, Deborah L., NASA Johnson Space Center, USA; Nimmagudda, Ram, Wyle Labs., Inc., USA; Berens, Kurt L., Wyle Labs., Inc., USA; Bourne, David W. A., Oklahoma Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 462-463; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The acute effects of exposure to microgravity include the development of space motion sickness which usually requires therapeutic intervention. The current drug of choice, promethazine (PMZ), has side effects which include nausea, drowsiness, dizziness, sedation and impaired psychomotor performance. In a ground-based study with commercial airline pilots and shuttle simulator trainers, we measured sleep and psychomotor performance variables, and physiological variables such as blood pressure and heart rate, as a function of circulating drug concentrations in the body. We evaluated a non-invasive sampling method (saliva) as a means of assessing pharmacodynamics following a single intramuscular (IM) dose of PMZ.

Author

Saliva; Pharmacology; Promethazine; Microgravity; Exposure; Physiological Effects; Psychomotor Performance

20000020627 Wisconsin Univ., Dept. of Nutritional Sciences, Madison, WI USA

Measurement of Body Compostion for Nutritional Assessment in Space Flight

Schoeller, Dale A., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 464-465; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long term space flight increases the risk of reduced human performance due to the loss of body cell mass from the combined effects of weightlessness and energy imbalance. Loss of body mass can now be measured during space flight, but this cannot be assumed to equal body cell mass as loss in mass can also result from decreases in body water or loss of body fat. In order to determine whether the loss of body mass results from loss of body cell mass or other components of body mass, it is necessary to measure body composition. At this time, no methods have been validated for the measurement of body composition during space flight. to address this limitation, we will validate the use of bioelectrical impedance analysis to measure the change in body composition in simulated microgravity.

Author

Bioelectricity; Body Fluids; Losses; Microgravity; Water Loss; Weightlessness; Cells (Biology)

20000020628 NASA Johnson Space Center, Houston, TX USA

Calcium Kinetics During Space Flight

Smith, Scott M., NASA Johnson Space Center, USA; Wastney, Meryl E., Georgetown Univ. Medical Center, USA; OBrien, Kimberly O., Johns Hopkins Univ., USA; Lane, Helen W., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 466; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Bone loss is one of the most detrimental effects of space flight, threatening to limit the duration of human space missions. The ability to understand and counteract this loss will be critical for crew health and safety during and after extended-duration missions. The hypotheses to be tested in this project are that space flight alters calcium homeostasis and bone mineral metabolism, and that calcium homeostasis and bone mineral metabolism will return to baseline within days to weeks of return to Earth. These hypotheses will be evidenced by elevated rates of bone mineral resorption and decreased bone mineral deposition, decreased absorption of dietary calcium, altered calcitropic endocrine profiles, elevated excretion of calcium in urine and feces, and elevated excretion of markers of bone resorption. The second hypothesis will be evidenced by return of indices of calcium homeostasis and bone metabolism to preflight levels within days to weeks of return to Earth. Studies will be conducted on International Space Station astronauts before, during, and after extended-duration flights. Measurements of calcium kinetics, bone mass, and endocrine/biochemical markers of bone and calcium homeostasis will be conducted. Kinetic studies utilizing dual isotope tracer kinetic studies and mathematical modeling techniques will allow for determination of bone calcium deposition, bone calcium resorption, dietary calcium absorption and calcium excretion (both urinary and endogenous fecal excretion). These studies will build upon preliminary work conducted on the Russian Mir space station. The results from this project will be critical for clarifying how microgravity affects bone and calcium homeostasis, and will provide an important control point for assessment of countermeasure efficacy. These results are expected to aid in developing countermeasures for bone loss, both for space crews and for individuals on Earth who have metabolic bone diseases.

Author

Calcium Metabolism; Countermeasures; Biochemistry; Bone Demineralization; Homeostasis; Kinetics; Losses; Metabolic Diseases; Mineral Metabolism

20000020629 Medicine and Dentistry Univ. of New Jersey, Dept. of Surgery Science Center, Stratford, NJ USA

Protein-Energy Relationships During Space Flight

Stein, T. P., Medicine and Dentistry Univ. of New Jersey, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 467; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Protein metabolism has been investigated on five missions, three short term (Shuttle missions SLS 1, SLS2 and D2) and two long term missions (Skylab and NASA/MIR). Measurements made have included nitrogen balance (four missions), whole body protein kinetics with 15N glycine as the tracer (four missions) and 3-methyl histidine (four missions). Also available for comparison are bed rest studies with and without exercise. The following conclusions can be drawn: (i) No two missions are alike, (ii) Entry into orbit is associated with a metabolic stress response. (iii) Comparison of energy intake (5 missions) and energy balance (four missions) suggests that for at least three of the missions an energy deficit was a major factor in the protein loss. (iv) Serious energy deficits occur on mission with high mandatory exercise requirements. (v) Fidelity with the bed rest models is poor.
Author

Protein Metabolism; Physiological Responses; Nitrogen; Methyl Compounds; Kinetics; Energy Budgets

20000020630 Michigan Univ., Coll. of Pharmacy, Ann Arbor, MI USA

A Noninvasive Test for Gastric Emptying and Intestinal Absorption

Welage, Lynda S., Michigan Univ., USA; Amidon, Gordon L., Michigan Univ., USA; Rhie, Julie, National Cancer Inst., USA; Neudeck, Brien L., Michigan Univ., USA; Choe, Sally, Michigan Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 468-469; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gastric emptying depends on the size and densities of ingested particles including nondigestible food. In the low gravity environment in space, gastric emptying is expected to be altered due to the low gravitational force constant. Thus, gastrointestinal adaptation may occur in a microgravity environment. We have developed a pellet gastric emptying test composed of enteric coated particles of caffeine and acetaminophen of 0.7 and 3.6 mm in diameter. The enteric coat prevents dissolution in the stomach but allows for rapid dissolution in the small intestinal environment. In a gravity environment, it is expected that the large particles will empty slower than the small particles and will appear at a later time in the plasma, while particles of the same size would be expected to empty at the same rate.
Author

Gastrointestinal System; Intestines; Microgravity; Emptying

20000020631 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA

Radiation Session Summary

Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Miller, Jack, California Univ., Lawrence Berkeley Lab., USA; Huso, David L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 471-476; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The National Academy of Sciences (NAS) has identified radiation hazards as one of the potential "show stoppers" for long term human exploration of space. NASA supports a multi-disciplinary research effort encompassing diverse fields including radiation physics and transport, basic research in radiation carcinogenesis and research on behavioral effects. to supplement the current research effort, the National Council on Radiation Protection and Measurements (NCRP) has assembled Scientific Committee 1-7 (SC 1-7) to provide recommendations on further information that is required to develop radiation protection guidelines for manned missions beyond low earth orbit. Townsend presented an update on the recent activities of NCRP SC 1-7, and reviewed the knowledge base that will be required to accurately assess the risks to humans from exposure to the radiation environment of space. The presentations in the Radiation Session addressed the critical research needs identified by the NAS and the NCRP. These included: (1) characterization of the space radiation environment, (2) modeling and ground-based measurement of the fragmentation properties of heavy charged particles as they interact with shielding and tissue equivalent materials, (3) biodosimetry in astronauts, (4) ground- and flight-based studies to elucidate the mechanisms of biological response to space radiation (and potential interactions with microgravity), and (5) ground-based studies to quantify the risks of carcinogenesis and other damage to normal tissues that may ensue after exposure to different components of the space radiation environment.
Author

Biological Effects; Carcinogens; Damage; Exposure; Extraterrestrial Radiation; Physiological Responses; Radiation Dosage; Radiation Hazards

20000020632 NASA Johnson Space Center, Houston, TX USA

Radiation Measurements on the Russian MIR Orbital Station

Badhwar, Gautam D., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 477; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Russian Mir orbital station was launched into an orbit with a 51.65 deg inclination in March 1986. It has operated continuously in the altitude range of 380 to 460 km. Almost immediately, cosmonauts began to carry out missions to the station. to date, there have been some 25 Russian missions. As part of the NASA Mir Program, a comprehensive set of radiation measurements were made to map the radiation in all of the Mir module. Numerous radiation measurements have been made on the Mir station throughout its lifetime. However, the comparison of these measurements have been difficult because of different sensitivities of detectors, some active and some passive, differing self shielding and in most cases unknown location shielding. In spite of these complications, very significant progress in the knowledge of the radiation environment onboard the Mir station has been made. These results are directly applicable to expected radiation environment on the International Space Station. In this paper, we describe the combined results from all seven NASA Mir missions. We show: (1) the absorbed dose rate from trapped particles is well correlated with the atmospheric density computed nearly 400 days earlier than the time of observation, (2) developed a relationship between the absorbed dose rate from galactic cosmic rays to the deceleration potential derived using the Climax neutron monitor rate, giving a tool to predict GCR dose rates to +/- 15% nearly 90 days prior to observations, (3) describe the drift of the South Atlantic Anomaly (SAA) with time, (4) compare the predictions of the dose rates as a function of time from the November 6-8, 1998 solar particle event with observations, (5) compare measurements made with NASA Tissue Equivalent Proportional Counter (TEPC) with the ESA DOSTEL device, the Hungarian Pille system, and the Russian R-16 dosimeter. Implications of these measurements for the ISS will be discussed.

Author

Deceleration; Anomalies; Dosage; Mir Space Station; Neutron Counters; Solar Corpuscular Radiation; Solar Flares

20000020633 Maryland Univ., Dept. of Radiation Oncology, Baltimore, MD USA

Characterization of Treefoil Peptide Genes in Iron-Ion or X-Irradiated Human Cells

Balcer-Kubiczek, E. K., Maryland Univ., USA; Harrison, G. H., Maryland Univ., USA; Xu, J. F., Maryland Univ., USA; Zhou, X. F., Maryland Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 478-479; In English

Contract(s)/Grant(s): NAGW-4392; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The gastrointestinal (GI) tract is especially sensitive to ionizing radiation, probably because of its high rate of cell turn over. Most of the data in the literature concerns the histological/anatomical description of damage rather than functional studies. In fact, previous reports in humans have shown that, at doses of 2 Gy or more, functional abnormalities appear indicating that in radiation sensitive tissues the effects of radiation are not limited to cell death. GI functions are controlled in particular by GI peptides. One hypothesis is that ionizing radiation may modulate the synthesis and release of these peptides and consequently may contribute largely to abnormalities in GI function. However, no previous studies have been concerned with GI-specific gene expression in irradiated GI tissues. The family of human trefoil peptides comprises three members thus far, all of which are expressed in specific regions of the GI tract. In addition, two trefoil peptides, pS2 (TFFI) and HITF (TFF2) are expressed in breast tissue. Their exact function in GI and breast tissues is unclear but mucosal integrity, repair, mucin secretion and responsiveness to hormones have been shown. We recently isolated and characterized pS2 as a novel p53- and estrogen receptor-independent gene whose MRNA expression in several cells lines was found to be delayed 4 to 7 days after irradiation with X-rays, fission neutrons or 1 GeV/n Fe-ions. The aim of the present study was to determine whether pS2 and HITF have a similar induction kinetics in irradiated gastric and breast cell lines, and whether they have the phorbol ester (TPA) responsive element (TRE).

Author

Peptides; Gene Expression; Iron; Ions; X Rays; Cells (Biology); Gastrointestinal System; Ionizing Radiation

20000020635 San Francisco Univ., Physics Dept., CA USA

Radiation Dosimetry on Manned Space Missions and at Ground-Based Accelerators

Benton, E. V.; Benton, E. R., San Francisco Univ., USA; Frank, A. L., Eril Research, Inc., USA; Moyers, M. M., San Francisco Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 483; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exposure to ionizing radiation of space crews engaged in long-term space missions such as on space stations, Lunar bases and trips to Mars, poses a set of complex scientific and technological problems which are being resolved on the road toward achieving adequate radiation protection. At the same time, both space and ground-based radiobiological experiments, and

radiation sensitive biomedical experiments require adequate dosimetric support. In both areas, passive radiation detectors have in the past and are now playing an important role. Recently we have been conducting two separate but related experiments involving environmental radiation measurements aboard the Russian Mir Space Station and ground-based accelerators aimed at clarifying the role of proton-induced target fragmentation.
Author
Radiation Detectors; Ionizing Radiation; Sensitivity; Radiobiology; Radiation Protection

20000020638 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Simulation of Clusters of DNA Damage Induced by Ionizing Radiation Encountered in Spaceflight
Chatterjee, A., California Univ., Lawrence Berkeley Lab., USA; Holley, W. R., California Univ., Lawrence Berkeley Lab., USA; Mian, I. S., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 488-489; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Energetic Protons and Heavy Charged particles are present in the Galactic Cosmic Rays (GCR). Thus, an assessment of their possible harmful health effects to astronauts in long duration space flights above the earth's magnetic field is of high priority in NASA supported research. The research presented here is from our efforts in the NASA Specialized Center of Research and Training related to Radiation Health. Theoretical modeling of radiobiological effects of charged particles found in the GCR can provide very useful information which may not be obtainable through experiments alone. One such example is the production of clusters of damage by tracks of charged particles interacting with cellular DNA. Based on our general theory of radiation damage to DNA, it has been demonstrated that several damaged sites (base damage, single strand breaks and double strand breaks) can be produced in close proximity, generally within twenty base pairs. The severity of the clustering can vary greatly based on the quality of radiation. One recurring theme in our studies and a feature which distinguishes radiation damage from most other types of insult to DNA is the strong spatial correlations in the damage. The next obvious question is what are the biological consequences of such clustering? Furthermore, since clustering of damaged sites cannot be measured directly, is it possible to correlate theoretical estimates of the frequencies with which certain types of clusters are generated by particle tracks with selected biological end points? In this presentation, we demonstrate our initial efforts in correlating clusters of damage with experimentally measured unrejoined double strand breaks.
Author
Radiation Damage; Simulation; Radiobiology; Mathematical Models; Ionizing Radiation; Health; Estimates; Damage

20000020640 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Genetic Regulation of Charged Particle Mutagenesis in Human Cells
Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Gauny, S., California Univ., Lawrence Berkeley Lab., USA; Cherbonnel-Lasserre, C., Commissariat a l'Energie Atomique, France; Liu, W., California Univ., Lawrence Berkeley Lab., USA; Wiese, C., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 493-496; In English
Contract(s)/Grant(s): NASA Order T-864-W; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our studies use a series of syngeneic, and where possible, isogenic human B-lymphoblastoid cell lines to assess the genetic factors that modulate susceptibility apoptosis and their impact on the mutagenic risks of low fluence exposures to 1 GeV Fe ions and 55 MeV protons. These ions are representative of the types of charged particle radiation that are of particular significance for human health in the space radiation environment. The model system employs cell lines derived from the male donor WIL-2. These cells have a single X chromosome and they are hemizygous for one mutation marker, hypoxanthine phosphoribosyltransferase (HPRT). TK6 and WTK1 cells were each derived from descendants of WIL-2 and were each selected as heterozygotes for a second mutation marker, the thymidine kinase (TK) gene located on chromosome 17q. The HPRT and TK loci can detect many different types of mutations, from single basepair substitutions up to large scale loss of heterozygosity (LOH). The single expressing copy of TK in the TK6 and WTKI cell lines is found on the same copy of chromosome 17, and this allele can be identified by a restriction fragment length polymorphism (RFLP) identified when high molecular weight DNA is digested by the SacI restriction endonuclease and hybridized against the cDNA probe for TK. A large series of polymorphic linked markers has been identified that span more than 60 cM of DNA (approx. 60 megabasepairs) and distinguish the copy of chromosome 17 bearing the initially active TK allele from the copy of chromosome 17 bearing the silent TK allele in both TK6 and WTKI cells. TK6 cells express normal p53 protein while WTKI cells express homozygous mutant p53. Expression of mutant p53 can increase susceptibility to x-ray-induced mutations. It's been suggested that the increased mutagenesis in p53 mutant cells might be due to reduced apoptosis.
Author
Mutagens; Mutations; Deoxyribonucleic Acid; Extraterrestrial Radiation; Genetics; Health; Polymorphism

20000020641 Colorado State Univ., Dept. of Radiological Health Sciences, Fort Collins, CO USA

Mutagenic Effects of Fe-56 Radiation on Cultured Mammalian Cells

Lenarczyk, M., Colorado State Univ., USA; Ueno, A., Colorado State Univ., USA; Vannais, D., Colorado State Univ., USA; Warters, R., Utah Univ., USA; Roberts, J., Utah Univ., USA; Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Hei, T., Columbia Univ., USA; Waldren, C., Colorado State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 497-499; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Travelers in space will almost certainly be exposed to various kinds of ionizing radiation especially high linear energy transfer (LET) particles such as HZE Fe. Such exposures can cause mutations in somatic cells that can increase the risk of developing such genetic diseases as cancer. We have, therefore, measured the mutagenic potency of HZE Fe in culture mammalian cells and begun experiments to determine if mutagenicity can be reduced by radioprotective chemicals like WR-1065 and RibCys, a prodrug of L-cysteine.

Author

Radiation Effects; Radiation Protection; Cells (Biology); Exposure; Ionizing Radiation

20000020642 Pacific Northwest National Lab., Richland, WA USA

DNA Repair-Protein Relocalization After Heavy Ion Exposure

Metting, N. F., Pacific Northwest National Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 503-506; In English

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Ionizing radiation is good at making DNA double strand breaks, and high linear energy transfer (LET) radiations such as heavy ion particles are particularly efficient. For this reason, the proteins belonging to repair systems that deal with double strand breaks are of particular interest. One such protein is Ku, a component in the non-homologous recombination repair system. The Ku protein is an abundant, heterodimeric DNA end-binding complex, composed of one 70 and one 86 kDa subunit. Ku protein binds to DNA ends, nicks, gaps, and regions of transition between single and double-stranded structure. These binding properties suggest an important role in DNA repair. The Ku antigen is important in this study because it is present in relatively large copy numbers and it is part of a double-strand-break repair system. More importantly, we consistently measure an apparent upregulation in situ that is not verified by whole-cell-lysate immunoblot measurements. This apparent upregulation is triggered by very low doses of radiation, thus showing a potentially useful high sensitivity. However, elucidation of the mechanism underlying this phenomenon is still to be done.

Author

Deoxyribonucleic Acid; Exposure; Proteins; Maintenance; Ionizing Radiation; Dosage

20000020643 California Univ., Lawrence Berkeley Lab., Berkeley, CA USA

Accelerator-Based Studies of Heavy Ion Interactions Relevant to Space Biomedicine

Miller, J., California Univ., Lawrence Berkeley Lab., USA; Heilbronn, L., California Univ., Lawrence Berkeley Lab., USA; Zeitlin, C., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 507-510; In English

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Evaluation of the effects of space radiation on the crews of long duration space missions must take into account the interactions of high energy atomic nuclei in spacecraft and planetary habitat shielding and in the bodies of the astronauts. These heavy ions (i.e. heavier than hydrogen), while relatively small in number compared to the total galactic cosmic ray (GCR) charged particle flux, can produce disproportionately large effects by virtue of their high local energy deposition: a single traversal by a heavy charged particle can kill or, what may be worse, severely damage a cell. Research into the pertinent physics and biology of heavy ion interactions has consequently been assigned a high priority in a recent report by a task group of the National Research Council. Fragmentation of the incident heavy ions in shielding or in the human body will modify an initially well known radiation field and thereby complicate both spacecraft shielding design and the evaluation of potential radiation hazards. Since it is impractical to empirically test the radiation transport properties of each possible shielding material and configuration, a great deal of effort is going into the development of models of charged particle fragmentation and transport. Accurate nuclear fragmentation cross sections (probabilities), either in the form of measurements with thin targets or theoretical calculations, are needed for input to the transport models, and fluence measurements (numbers of fragments produced by interactions in thick targets) are needed both to validate the models and to test specific shielding materials and designs. Fluence data are also needed to characterize the incident radiation field in accelerator radiobiology experiments. For a number of years, nuclear fragmentation measurements at GCR-like energies have been carried out at heavy ion accelerators including the LBL Bevalac, Saturne (France), the

Synchrophasotron and Nuklotron (Dubna, Russia), SIS-18 (GSI, Germany), the Alternating Gradient Synchrotron at Brookhaven National Laboratory (BNL AGS) and the Heavy Ion Medical Accelerator (HIMAC) in Chiba, Japan. Until fairly recently most of these experiments were done to investigate fundamental problems in nuclear physics, but with the increasing interest in heavy charged particles on the part of the space flight, radiobiology and radiotherapy communities, an increasing number of experiments are being directed at these areas. Some of these measurements are discussed in references therein. Over the past several years, our group has taken cross section and fluence data at the AGS and HIMAC for several incident beams with nuclear charge, Z, between 6 and 26 at energies between 290 and 1050 MeV/nucleon. Iron (Z = 26) has been studied most extensively, since it is the heaviest ion present in significant numbers in the GCR. Targets have included tissue-equivalent and proposed shielding materials, as well as a variety of elemental targets for cross section measurements. Most of the data were taken along the beam axis, but measurements have been made off-axis, as well. Here we present selected data and briefly discuss some implications for spacecraft and planetary habitat design.
Author
Heavy Ions; Research; Biomedical Data; Damage; Human Body; Incident Radiation; Ion Accelerators; Spacecraft Design; Spacecraft Shielding

20000020644 Colorado State Univ., Dept. of Radiological Health Sciences, Fort Collins, CO USA
Molecular and Chromosomal Damage and MIS-Repair in Human X Chromosomes
Muhlmann-Diaz, M. C., Colorado State Univ., USA; Loebrich, M., California Univ., Lawrence Berkeley Lab., USA; Rydberg, B., California Univ., Lawrence Berkeley Lab., USA; Cooper, P. K., California Univ., Lawrence Berkeley Lab., USA; Bedford, J. S., Colorado State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 511-512; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The structure and/or activity of chromatin is known to influence substantially the damage and damage processing in cells after exposure to both ionizing and non-ionizing radiations as well as other genotoxic agents. There is virtually no information, however, on the comparison of ionizing radiation damage and its processing at the DNA and chromosome levels in relation to the influence of chromatin structure/activity. to study this question, we compared initial ionizing radiation damage in terms of DNA double strand breaks and breaks in prematurely condensed chromatin as well as the end product of mis-repair in DNA and the development of chromosomal aberrations in human X chromosomes of cells from normal males, females with an active and an inactive X, and individuals with supernumerary X chromosomes which are particularly inactive. The object was to determine whether the total initial and mis-repaired damage per cell simply increased in proportion to the number of X chromosomes, or whether one or the other (or both) damage end-points varied depending (presumably) on the known differences in structure/activity of the X chromosomes in these cells.
Author
Chromosomes; Molecules; Radiation Damage; Maintenance

20000020645 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Modulation of Radiogenic Damage by Microgravity: Results From STS-76
Nelson, Gregory, Loma Linda Univ., USA; Kazarians, Gayane, Loma Linda Univ., USA; Schubert, Wayne, Jet Propulsion Lab., California Inst. of Tech., USA; Kern, Roger, Jet Propulsion Lab., California Inst. of Tech., USA; Schranck, David, Jet Propulsion Lab., California Inst. of Tech., USA; Hartman, Philip, Texas Christian Univ., USA; Hlavacek, Anthony, Texas Christian Univ., USA; Wilde, Honor, Texas Christian Univ., USA; Lewicki, Dan, Texas Christian Univ., USA; Benton, Eugene, San Francisco Univ., USA; Benton, Eric, San Francisco Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 515-516; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The STS-76 (Shuttle-Mir 3) spaceflight provided an opportunity to test two questions about radiation responses in C. elegans. First, does the absence of gravity modify the dose-response relation for mutation and chromosome aberration and second, what are the features of the mutation spectrum resulting from exposure to cosmic rays? These questions were put to the test in space using the ESA "Biorack" facility which was housed in the Spacehab module aboard shuttle Atlantis. The mission flew in March, 1996 and was a shuttle rendezvous with the Russian space station Mir.
Author
Damage; Chromosomes; Mutations; Gravitation; Radiation Dosage

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Some Behavioral Effects of Exposure to Low Doses of Fe-56 Particles

Rabin, Bernard M., Maryland Univ. Baltimore County, USA; Joseph, James A., Tufts Univ., USA; Shukitt-Hale, Barbara, Tufts Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 517-519; In English
Contract(s)/Grant(s): NAGW-4394; NAG5-6093; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Future missions in space (such as a mission to Mars) will involve long-term travel beyond the magnetic field of the Earth. As a result, astronauts will be exposed to radiation qualities and doses that differ from those experienced in low earth orbit, including exposure to heavy particles, such as Fe-56, which are a component of cosmic rays. Although the hazards of exposure to heavy particles are often minimized, they can affect neural functioning, and as a consequence, behavior. Unless the effects of exposure to cosmic rays can somehow be reduced, their effects on the brain throughout long duration flights could be disastrous. In the extreme case, it is possible that the effects of cosmic rays on space travelers could result in symptomatology resembling that of Alzheimer's or Parkinson's diseases or of advancing age, including significant cognitive and/or motor impairments. Because successful operations in space depend in part on the performance capabilities of astronauts, such impairments could jeopardize their ability to satisfy mission requirements, as well as have long-term consequences on the health of astronauts. As such, understanding the nature and extent of this risk may be vital to the effective performance and possibly the survival of astronauts during future missions in space.
Author

Iron Isotopes; Heavy Ions; Cosmic Rays; Dosage; Exposure; Hazards; Health

20000020647 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA

Non-Rejoined DNA Double-Strand Breaks in Human Cells. A Shift in RBE versus LET for HZE Iron Particles in Comparison with Low Energy Helium Particles

Rydberg, B., California Univ., Lawrence Berkeley Lab., USA; Cooper, P. K., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 520; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

DNA double-strand breaks (dsbs) are likeley to be the most important lesions produced by ionizing radiation. Among the dsbs, those that are either misrejoined or remain unrejoined a long time after induction are probably the most relevant for a variety of biological endpoints. We present here results of unrejoined dsbs in human fibroblasts 16 hrs after irradiation with Energy Heavy Ions (HZE) Fe particles with LETs of 190 and 150 keV/micron and compare this with similar results with He particles in the Linear Energy Transfer (LET) range of 65-160 keV/micron.
Author

Deoxyribonucleic Acid; Linear Energy Transfer (LET); Cells (Biology); Relative Biological Effectiveness (RBE); Particle Energy; Ionizing Radiation

20000020648 Texas A&M Univ., Center for Genome Research, Houston, TX USA

Quantitation of Radiation Induced Deletion and Recombination Events Associated with Repeated DNA Sequences

Sinden, Richard R., Texas A&M Univ., USA; Ford, John R., Texas A&M Univ., USA; Braby, Leslie A., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 521-523; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Manned exploration of space exposes the explorers to a complex and novel radiation environment. The galactic cosmic ray component of this environment is relatively constant, and the variations with the solar cycle are well understood and predictable. However, a significant fraction of the dose may be delivered by solar particle events which vary dramatically in dose rate and incident particle spectrum. When these radiations interact with spacecraft materials and added shielding they produce a spectrum of secondary particles which depends on the spectrum of the incident particles as well as the shielding material. The different particle types and energies result in different patterns of energy deposition at the molecular and cellular level. Differences in these energy deposition patterns significantly alter the ability of cellular systems to repair the resulting damage. It is likely that these differences also effect the spatial distribution of damage within the DNA of the interphase cell nucleus and produce corresponding differences in endpoints related to health effects. Nearly one-third of the human genome is composed of DNA repeats, which include simple mono-, di-, tri-, and tetranucleotide repeats; widely separated small and large repeats; and inverted repeats. Mutations associated with repetitive DNA are a source of many genetic diseases and cancer. In fact, the vast majority of mutations leading to human disease likely result from replication errors involving misalignment between repeated DNAs. Therefore, understanding how the various kinds of repeats contribute to the disease burden and understanding the impact of DNA damage on repeat-associated genomic instability is important for human health. DNA damage from ionizing radiation induces DNA structures and DNA repair events that can promote errors associated with repeated DNA sequences. Such repeated DNA

sequences are likely to be very prone to mutation following exposure to high-Z high-energy (HZE) particles during space flight. Cells in the direct line of the HZE particle sustain a high dose of energy while cells surrounding the primary tract sustain a lower dose of energy from the energetic delta rays (electrons) produced by HZE particles. Therefore, the nature and pattern DNA damage to cells in tissue upon irradiation with HZE particles is particularly complex. It is important to understand the types of mutational changes induced by both the HZE particles as well as the delta rays.
Author
Quantitative Analysis; Irradiation; Deoxyribonucleic Acid; Damage; Deletion; Dosage; Energy Transfer; Genetics; Ionizing Radiation

20000020649 Tennessee Univ., Dept. of Nuclear Engineering, Knoxville, TN USA
Information Needed to Make Radiation Protection Recommendations for Travel Beyond Low-Earth Orbit
Townsend, Lawrence W., Tennessee Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 524; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Scientific Committee 1-7 (SC 1-7) of the National Council on Radiation Protection and Measurements (NCRP) has been assembled for the purpose of providing recommendations to NASA concerning the information needed to make radiation protection guidelines for manned space missions beyond low-Earth orbit. Current space radiation limits pertain only to missions in low-Earth orbit and are not considered relevant for future deep space missions. SC 1-7 has met numerous times over the past three years to review the current status of scientific knowledge relevant to this task. The committee is currently formulating a set of recommendations for additional research needed to provide the data necessary to establish astronaut radiation limits for exomagnetospheric missions, such as a Lunar base or mission to Mars. In this presentation, the procedures followed by the NCRP for making recommendations are briefly discussed. The composition of SC 1-7 and the scope of its efforts and activities are presented. Brief overviews of the current status and shortcomings of scientific knowledge of the space radiation environment, radiation physics and transport, radiation biology, dosimetry and radiation risk are presented. However, formal recommendations of research necessary to establish radiation limits for deep space missions will not be presented since they have not been developed by the committee or approved by the Council.
Author
Extraterrestrial Radiation; Formulations; Low Earth Orbits; Manned Space Flight; Radiation Protection

20000020650 ANSER Corp., Arlington, VA USA
Risk Management Strategies During Solar Events
Turner, Ron, ANSER Corp., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 525; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The natural radiation from galactic cosmic rays (GCR) and solar particle events (SPEs) will pose a serious health risk to humans during missions to Mars or the Moon. The opportunities and limitations of astronauts on these missions will be constrained by the radiation environment and NASA's response to it. NASA recognizes both an ethical and legal responsibility to minimize the acute and long-term risks to astronauts during space flight. There is an extensive program underway to collect statistically meaningful data to understand the fundamental biological impacts of the radiation environment. These data can be directly related to the well-characterized incident, slowly varying, galactic cosmic ray flux. There is greater uncertainty in predicting and characterizing the rapidly changing solar particle radiation which, over time periods of hours to days, can produce particle fluences comparable to mission-long GCR fluence. Work by this investigator in an earlier grant (NAGW-4166) systematically identified the types of solar particle events (SPEs), the stages of a human Lunar or Mars mission when the events may occur, and the methods used to detect and forecast these events. Alternative scenarios were identified that represented the range of architectures that could be employed to mitigate SPE risk. The advantages and disadvantages of each scenario were discussed. Based on the earlier results, we initiated a program to continue this research through a sequence of additional phases that will progressively add to NASA's ability to develop a comprehensive SPE risk management strategy. These subsequent phases examine in more detail the science, engineering, and operational requirements. The focus in each phase is to identify the key issues and general approaches to address these issues, rather than to attempt to specify a particular solution. This presentation will include a short review of the physics of SPEs and the current ability to forecast SPEs. It will then cover techniques to observe SPEs and the solar precursers to SPEs.
Author
Galactic Cosmic Rays; Solar Storms; Data Acquisition; Health; Legal Liability; Solar Flares

20000020651 Utah Univ., Health Sciences Center, Salt Lake City, UT USA

Aminothiol Induced Modulation of p53 Protein Activity in Human Cells

Warters, Raymond L., Utah Univ., USA; Thai, David K., Utah Univ., USA; Roberts, Jeanette C., Utah Univ., USA; Gaffney, David K., Utah Univ., USA; Cress, Anne E., Arizona Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 526-527; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The aminothiols (S-2-(3-aminopropylamino)ethylphosphorothioic acid (WR1065) and the thiazolidine prodrug Ribose Cysteine (RibCys) have been reported to be antimutagenic in mammalian cells when present either during irradiation, or more significantly when present only after irradiation. The antimutagenesis effect mediated by these agents when present during irradiation may be attributable to their ability to reduce radiation-induced DNA damage. The antimutagenesis effect observed when these agents are added well after irradiation must be due to some modification of the cell's response to DNA damage. In an attempt to better understand this modulation of the cellular response to radiation, we are investigating the intracellular changes in cells exposed either to ionizing radiation or aminothiols.

Author

Amino Radical; Cells (Biology); Radiation Damage; Ionizing Radiation

20000020653 NASA Langley Research Center, Hampton, VA USA

Impact of Track Structure Effects on Shielding and Dosimetry

Wilson, J. W., NASA Langley Research Center, USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Schimmerling, W., NASA, USA; Kim, M. Y., NASA Langley Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 529-532; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Galactic cosmic rays (GCR) consisting of nuclei of all the known elements with kinetic energies extending from tens to millions of MeV pose a significant health hazard to future deep space operations. Even half of the radiation exposures expected in ISS will result from GCR components. The biological actions of these radiations are known to depend on the details of the energy deposition (not just linear energy transfer, LET, but the lateral dispersion of energy deposition about the particle track). Energy deposits in tissues are dominated by the transfer of tens to hundreds of eV to the tissue's atomic electrons. In the case of low LET radiations, the collisions are separated by large dimensions compared to the size of important biomolecular structures. If such events are also separated in time, then the radiation adds little to the background of radicals occurring from ordinary metabolic processes and causes little or no biological injury. Hence, dose rate is a strong determinant of the action of low LET exposures. The GCR exposures are dominated by ions of high charge and energy (HZE) characterized by many collisions with atomic electrons over biomolecular dimensions, resulting in high radical- density events associated with a few isolated ion paths through the cell and minimal dose rate dependence at ordinary exposure levels. The HZE energy deposit declines quickly laterally and merges with the background radical density in the track periphery for which the exact lateral distribution of the energy deposit is the determinant of the biological injury. Although little data exists on human exposures from HZE radiations, limited studies in mice and mammalian cell cultures allow evaluation of the effects of track structure on shield attenuation properties and evaluation of implications for dosimetry. The most complete mammalian cell HZE exposure data sets have been modeled including the C3H10T1/2 survival and transformation data of Yang et al., the V79 survival and mutation data of various groups, and the Harderian gland tumor data of Alpen et al. Model results for the Harderian gland tumor data in comparison with data from Alpen et al. The Harderian target cell initiation cross section compares closely with the transformation cross section found for the C3H10T1/2 cell transformation data of Yang et al. The most notable feature of the cross sections are the multivalued cross sections for a given LET which implies the corresponding relative biological effectiveness (RBE) is dependent not only on the LET but also the ion type. This fact is at variance with the latest ICRP recommended quality factor which is a defined function of only the LET.

Author

Galactic Cosmic Rays; Dosimeters; Energy Transfer; Exposure; Hazards; Mutations; Radiation Dosage; Relative Biological Effectiveness (RBE)

20000020654 NASA Johnson Space Center, Houston, TX USA

Analysis of Incomplete Chromosomal Exchanges Using Fluorescence In Situ Hybridization with Telomere Probes

Wu, H., NASA Johnson Space Center, USA; George, K., NASA Johnson Space Center, USA; Yang, T. C., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 533; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

To determine the frequency of true incomplete exchanges induced by both low- and high-LET radiation.

Author

Linear Energy Transfer (LET); Chromosomes; Research

20000020655 Baylor Coll. of Medicine, Houston, TX USA

Sleep/Circadian Rhythm Session Summary

Dinges, David F., Baylor Coll. of Medicine, USA; Czeisler, Charles A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 535-537; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sleep and circadian rhythm systems are fundamental regulatory processes of the nervous system, and the most ubiquitous endogenous controls of human biobehavioral functions - everyone is internally programmed to sleep every night. The need for sleep is a homeostatic drive that occurs regardless of time of day, but it is also modulated by the endogenous circadian pacemaker. Conversely, the endogenous circadian pacemaker oscillates regardless of the need for sleep, although its promotion of wakefulness can be overwhelmed by elevated homeostatic sleep drive. These two powerful neurobiological systems interact continuously to control brain state (i.e., waking vs. sleep) and the intensity of state (e.g., alert vs. sleepy). Sleep and circadian rhythmicity also temporally modulate a wide range of physiological functions (e.g., body temperature, cardiovascular activity, respiration, immune responses), hormonal functions (e.g., growth hormone, melatonin, cortisol, thyroid hormones), behavioral functions (e.g., movement, posture, reaction time), and cognitive functions (e.g., fatigue, alertness, vigilance, memory, cognitive throughput). No astronaut-no matter how much training, preparation, nutrition, psychosocial support, or environmental protection is provided -is immune from the daily control of physiology and performance by the homeostatic drive for sleep and the endogenous circadian timing system. Failure to take these two interactive neurobiological imperatives into account when planning human activities in space will have catastrophic consequences. The need for sleep and the circadian pacemaker have a sustained influence over many biomedical systems essential for maintaining astronaut physical condition, mental health, and performance capability. Dysfunction of sleep and circadian systems can adversely affect an organism's ability to respond to environmental challenges and has been linked to physiological and psychological disorders. This area therefore has a high degree of relevance to a number of other space life science technical areas including research on muscle and bone loss, cardiovascular and immune changes, neurovestibular alterations and nutritional needs, and behavioral and psychological health in space flight.

Author

Alertness; Body Temperature; Bone Demineralization; Cardiovascular System; Circadian Rhythms; Mental Health; Nervous System; Physiological Responses; Sleep; Wakefulness

20000020657 Massachusetts General Hospital, Statistics Research Lab., Boston, MA USA

Dynamic Assessment of Circadian Phase and Amplitude Under the Simulated Lighting Conditions of Long-Duration Space Missions

Brown, E. N., Massachusetts General Hospital, USA; Luithardt, H. H., Massachusetts General Hospital, USA; Wright, K. P., Jr., Brigham and Women's Hospital, USA; Czeisler, Charles A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 541-542; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Maintenance of physiologic and neurobehavioral homeostasis during long-duration space missions is crucial for ensuring optimal crew performance. Alterations in the circadian system will occur due to loss of contact with the normal geophysical light-dark cycles. Assessing the status of the circadian system is an especially challenging task because this normally requires special protocols such as the constant routine, free-run and forced desynchrony. We are developing statistical methods to make dynamic assessments of circadian phase and amplitude from core-temperature measurements collected under the simulated lighting conditions of long- duration space missions.

Author

Statistical Analysis; Dynamic Characteristics; Circadian Rhythms; Physiology; Long Duration Space Flight; Human Performance; Homeostasis

20000020658 Massachusetts Inst. of Tech., Man-Vehicle Lab., Cambridge, MA USA

Effectiveness of an Expert System for Astronaut Assistance on a Sleep Experiment

Callini, G., Massachusetts Inst. of Tech., USA; Essig, S. M., Massachusetts Inst. of Tech., USA; Heher, D., Caelum Research Corp., USA; Young, L. R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 543; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Principal Investigator-in-a-Box ([PI]) is an expert system designed to train and assist astronauts with the performance of an experiment outside their field of expertise, particularly when contact with the Principal Investigators on the ground is limited or impossible. In the current case, [PI] was designed to assist with the calibration and troubleshooting procedures of the Neurolab

Sleep and Respiration Experiment during the pre-sleep period of no ground contact. It displays physiological signals in real time during the pre-sleep instrumentation period, and alerts the astronauts when a poor signal quality is detected.
Author
Effectiveness; Expert Systems; Respiration; Sleep; Experimentation

20000020659 NASA Ames Research Center, Moffett Field, CA USA
Ambient Light Intensity, Actigraphy, Sleep and Respiration, Circadian Temperature and Melatonin Rhythms and Daytime Performance of Crew Members During Space Flight on STS-90 and STS-95 Missions
Czeisler, Charles A., Brigham and Women's Hospital, USA; Dijk, D.-J., Brigham and Women's Hospital, USA; Neri, D. F., California Univ., USA; Hughes, R. J., Brigham and Women's Hospital, USA; Ronda, J. M., Brigham and Women's Hospital, USA; Wyatt, J. K., Brigham and Women's Hospital, USA; West, J. B., California Univ., USA; Prisk, G. K., California Univ., USA; Elliott, A. R., California Univ., USA; Young, L. R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 544-546; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sleep disruption and associated waking sleepiness and fatigue are common during space flight. A survey of 58 crew members from nine space shuttle missions revealed that most suffered from sleep disruption, and reportedly slept an average of only 6.1 hours per day of flight as compared to an average of 7.9 hours per day on the ground. Nineteen percent of crewmembers on single shift missions and 50 percent of the crewmembers in dual shift operations reported sleeping pill usage (benzodiazepines) during their missions. Benzodiazepines are effective as hypnotics, however, not without adverse side effects including carryover sedation and performance impairment, anterograde amnesia, and alterations in sleep EEG. Our preliminary ground-based data suggest that pre-sleep administration of 0.3 mg of the pineal hormone melatonin may have the acute hypnotic properties needed for treating the sleep disruption of space flight without producing the adverse side effects associated with benzodiazepines. We hypothesize that pre-sleep administration of melatonin will result in decreased sleep latency, reduced nocturnal sleep disruption, improved sleep efficiency, and enhanced next-day alertness and cognitive performance both in ground-based simulations and during the space shuttle missions. Specifically, we have carried out experiments in which: (1) ambient light intensity aboard the space shuttle is assessed during flight; (2) the impact of space flight on sleep (assessed polysomnographically and actigraphically), respiration during sleep, circadian temperature and melatonin rhythms, waking neurobehavioral alertness and performance is assessed in crew members of the Neurolab and STS-95 missions; (3) the effectiveness of melatonin as a hypnotic is assessed independently of its effects on the phase of the endogenous circadian pacemaker in ground-based studies, using a powerful experimental model of the dyssomnia of space flight; (4) the effectiveness of melatonin as a hypnotic is assessed during the STS-90 (Neurolab) and STS-95 missions in a double-blind placebo-controlled trial. In both flight-based experiments, the effects of melatonin on sleep stages and spectral composition of the EEG during sleep will be determined as well as its effects on daytime alertness and performance; (5) the impact of space flight on sleep and waking neurobehavioral alertness and performance in 30-45-year-old astronauts is compared with its impact in a 77-year-old astronaut. This case study is the first to assess the effects of space flight on an older individual. Because the investigators are still blind to the treatment in this double-blind, placebo-controlled trial, preliminary results will be presented independent of the drug condition.
Author
Luminous Intensity; Alertness; Circadian Rhythms; Disorders; Electroencephalography; Mental Performance; Simulation; Surveys

20000020660 Brigham and Women's Hospital, Boston, MA USA
Electroencephalographic and Ocular Correlates of Neurobehavioral Performance Decrements
Dijk, Derk-Jan, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 547-550; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Neurobehavioral performance of astronauts during long duration space flight may be compromised by sleep loss, non-24 h rest-activity cycles, desynchrony of the sleep-wake cycle and endogenous circadian rhythms as well as micro-gravity itself. Ground-based research has demonstrated that all of these factors contribute significantly to neurobehavioral performance decrements and interact in a complex non-additive manner. In particular, it has been shown that prolonged partial sleep loss, i.e., loss of 3-4 hours of sleep per night, results in a progressive deterioration of neurobehavioral performance. Furthermore, it has been demonstrated that stable levels of alertness and cognitive throughput during a 16-18 h wake episode are critically dependent on the maintenance of an appropriate phase relationship between the sleep-wake cycle and the circadian timing system. When this appropriate phase relationship is not maintained neurobehavioral performance deteriorates even within an episode of wakefulness of 16 h in duration. Finally, posture has been shown to interact with the effects of the hormone melatonin on subjective alertness as well as the spectral composition of the electroencephalogram (EEG), such that it appears that humans are more susceptible to

the effects of melatonin when in a supine position. Previous research has indicated that sleep loss and circadian phase affect the EEG during sleep as well as during wakefulness. EEG and ocular (EOG) parameters recorded during wakefulness are associated with neurobehavioral performance decrements in the laboratory as well as in real life situations. However, this association of EEG and EOG parameters with neurobehavioral performance has not been investigated under conditions in which a wide variety of combinations of sleep pressure (i.e., wake duration) and circadian phase has been realized. Furthermore, the interaction between these independent variables and posture has not been investigated in detail. The aim of the present research is to investigate the robustness of the associations between EEG/EOG parameters and neurobehavioral performance and to identify new associations under conditions in which circadian phase, circadian amplitude, sleep pressure and posture are manipulated. Identification of EEG and EOG parameters that are highly correlated with neurobehavioral performance under these conditions could lead to the development of algorithms and devices that allow on-line and non-invasive monitoring, as well as prediction, of neurobehavioral performance during long duration space flight.
Author
Electroencephalography; Performance Prediction; Neuromuscular Transmission; Alertness; Circadian Rhythms; Losses; Sleep; Wakefulness

20000020661 Baylor Coll. of Medicine, Houston, TX USA
Countermeasures to Neurobehavioral Deficits from Cumulative Partial Sleep Deprivation During Space Flight
Dinges, David F., Baylor Coll. of Medicine, USA; VanDongen, H. P. A.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 551-553; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The performance capability of astronauts during extended-duration space flight depends heavily on achieving recovery through adequate sleep. Even with appropriate circadian alignment, sleep loss will erode fundamental elements of human neurobehavioral performance capability including vigilance, cognitive speed and accuracy, working memory, reaction time, and physiological alertness. Our preliminary experiments have revealed that these deficits occur reliably when sleep is limited to 6 hr per day. Such chronic sleep restriction has been a common experience during manned space flight, occurring in response to endogenous disturbances of sleep (motion sickness, stress, circadian rhythms), environmental disruptions of sleep (noise, temperature, light), and curtailment of sleep due to the work demands that accompany extended space flight operations. In order to prevent cumulative waking deficits resulting from sleep restriction, research suggests that the sleep drive must be met through increased duration of the major (anchor) sleep period, and/or through the strategic use of a single pre-planned (preemptive) nap each day. The implementation of a brief nap may be an important way in which cumulative sleep loss and waking performance deficits could be reversed or prevented. However, nap strategies have not been systematically tested as countermeasures to performance impairment from cumulative anchor sleep restriction. Thus, there is a critical deficiency in knowledge of which combinations of anchor sleep and nap durations yield the most efficient return of performance per unit time invested in sleep. The primary aim of this project is to meet this critical deficiency through utilization of a response surface model design, testing in a dose-response manner varying combinations of anchor sleep and nap sleep durations for the purpose of establishing how to most effectively and efficiently limit the cumulative effects of chronic sleep restriction in space operations. A search algorithm involving two-stage regression analyses is being used to test the hypothesis that the addition of a relatively brief preemptive nap to restricted sleep each day markedly attenuates the cumulative performance deficits developing across days. This approach is also being used to explore the possibility that the addition of a nap to anchor sleeps increases sleep-related secretion of growth hormone, which may be a countermeasure for the effects of microgravity on muscle and loss in prolonged space flight.
Author
Countermeasures; Neuromuscular Transmission; Sleep; Alertness; Circadian Rhythms; Human Performance; Muscles

20000020662 California Univ., Section of NPB, Davis, CA USA
The Effects of Gravity on the Circadian Timing System
Fuller, Charles A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 554; In English
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All vertebrates have a physiological control system that regulates the timing of the rhythms of their daily life. Dysfunction of this system, the circadian timing system (CTS), adversely affects an organism's ability to respond to environmental challenges and has been linked to physiological and psychological disorders. Exposure to altered gravitational environments (the microgravity of space and hyperdynamic environments produced via centrifugation) produces changes in both the functioning of the CTS and the rhythmic variables it controls. The earliest record of primate rhythms in a spaceflight environment come from Biosatellite III. The subject, a pig-tailed macaque, showed a loss of synchronization of the body temperature rhythm and a

fragmented sleep-wake cycle. Alterations in the rhythm of body temperature were also seen in rhesus macaques flown on COSMOS 1514. Squirrel monkeys exposed to chronic centrifugation showed an initial decrease in the amplitude and mean of their body temperature and activity rhythms. In a microgravity environment, Squirrel monkeys on Spacelab-3 showed a reduction in the mean and amplitude of their feeding rhythms. Since 1992 we have had the opportunity to participate on three US/Russian sponsored biosatellite missions on which a total of six juvenile male rhesus macaques were flown. These animals uniformly exhibited delays in the phasing of their temperature rhythms, but not their heart rate or activity rhythms during spaceflight. There was also a tendency for changes in waveform mean and amplitude. These data suggest that the spaceflight environment may have a differential effect on the different oscillators controlling different rhythmic variables. Ongoing studies are examining the effects of +G on the CTS. The long-term presence of humans in space highlights the need for effective countermeasures to gravitational effects on the CTS.
Author
Animals; Gravitational Effects; Circadian Rhythms; Countermeasures; Losses; Microgravity; Vertebrates

20000020663 Brigham and Women's Hospital, Boston, MA USA
Melatonin as a Countermeasure for Entrainment to the Sleep/Wake Schedules Required During Shuttle Missions
Khalsa, Sat Bir S., Brigham and Women's Hospital, USA; Dijk, Derk-Jan, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 555-558; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Most if not all physiologic and behavioral variables in humans exhibit endogenous circadian rhythms with a period of about 24.2 hours. On earth, a stable phase relation between circadian rhythms and the 24-hr day is maintained by a process called entrainment, in which the daily alternation of light and darkness is the most important periodic environmental agent. Although bright light has been shown to be effective in synchronizing and resetting the human circadian pacemaker, the effects of dim levels of light have limited effectiveness in maintaining synchronization, especially when the imposed light/dark cycle is shifted with respect to the habitual sleep/wake cycle. This is the case for shuttle astronauts who are typically exposed to recurrent "sleep cycle shifting" due to mission-dependent orbital mechanics and mission duration requirements and is equivalent to imposition of a shorter-than-24 hour day. Power requirements on the shuttle necessitate a restricted level of ambient lighting. Together, these conditions are likely to result in misalignment of the endogenous circadian timing system with respect to the desired sleep/wake cycle, even among crew members who begin the mission with their sleep- wake cycle well adapted to mission elapsed time on the day of launch.
Author
Countermeasures; Sleep; Wakes; Misalignment; Physiology; Darkness; Circadian Rhythms

20000020664 Pittsburgh Univ., Sleep and Chronobiology Center, Pittsburgh, PA USA
Sleep and Circadian Rhythms in Four Orbiting Astronauts
Monk, Timothy H., Pittsburgh Univ., USA; Buysse, Daniel J., Pittsburgh Univ., USA; Billy, Bart D., Pittsburgh Univ., USA; Kennedy, Kathy S., Pittsburgh Univ., USA; Willrich, Linda M., Pittsburgh Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 559-560; In English
Contract(s)/Grant(s): NAS9-18404; NAS9-19407; NIH-MH-01235; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

INTRODUCTION The study of human sleep and circadian rhythms in space has both operational and scientific significance. Operationally, U.S. Spaceflight is moving away from brief missions with durations of less than one week. Most space shuttle missions now last two weeks or more, and future plans involving space stations, lunar bases and interplanetary missions all presume that people will be living away from the gravity and time cues of earth for months at a time. Thus, missions are moving away from situations where astronauts can "tough it out" for comparatively brief durations, to situations where sleep and circadian disruptions are likely to become chronic, and thus resistant to short term pharmacological or behavioral manipulations. As well as the operational significance, there is a strong theoretical imperative for studying the sleep and circadian rhythms of people who are removed from the gravity and time cues of earth. Like other animals, in humans, the Circadian Timekeeping System (CTS) is entrained to the correct period (24h) and temporal orientation by various time cues ("zeitgebers"), the most powerful of which is the alternation of daylight and darkness. In leaving Earth, astronauts are removing themselves from the prime zeitgeber of their circadian system -- the 24h alternation of daylight and darkness.
Author
Circadian Rhythms; Sleep; Astronauts; Darkness; Daytime; Gravitation; Space Flight

20000020665 Beth Israel Deaconess Medical Center, Boston, MA USA

Neuroendocrine and Neuroimmune Modulation by Sleep Deprivation

Mullington, J., Beth Israel Deaconess Medical Center, USA; Carlin, M., Pennsylvania Univ., USA; Kapoor, S., Pennsylvania Univ., USA; Price, N., Pennsylvania Univ., USA; Szuba, M., Pennsylvania Univ., USA; Schwartz, R., Baylor Coll. of Medicine, USA; Shearer, W., Baylor Coll. of Medicine, USA; Butel, J., Baylor Coll. of Medicine, USA; Dinges, D. F., Pennsylvania Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 561-562; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Animal studies have shown that sleep deprivation impairs prognostic outcome during infectious disease in rabbits. We are analyzing blood sampled from subjects participating in a number of sleep deprivation conditions. We will present results of ongoing studies on the effects of total (TSD) and partial sleep deprivation (PSD) on neuroendocrine and neuroimmune parameters in humans.

Author

Neurophysiology; Endocrine Systems; Immune Systems; Sleep Deprivation; Data Acquisition

20000020666 California Univ., Section of NPB, Davis, CA USA

BRN 3.1 Knockouts Affect the Vestibular, Autonomic, and Circadian Rhythm Responses to 2G Exposure

Murakami, D. M., California Univ., USA; Erkman, L., California Univ., USA; Rosenfeld, M. G., California Univ., USA; Fuller, C. A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 563-564; In English

Contract(s)/Grant(s): NAGW-4552; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our previous studies have demonstrated that 2G exposure via centrifugation significantly attenuated the daily mean and circadian rhythm amplitude of rat body temperature (Tb), heart rate, and activity (Act). In addition, 2G exposure activates neural responses in several vestibular, autonomic, and circadian nuclei. Although we have characterized the effect of 2G on an animal's physiological, neuronal, and behavioral responses, it will be important to understand the underlying neural and physiological mechanisms that mediate those responses. For example, the vestibular responses, proprioceptive feedback, or fluid shifts may be the critical factors that mediate the responses to 2G. As a first step to understand the relative importance of these different response pathways to altered gravitational fields, this study examined the contribution of the vestibular system by utilizing an animal model from molecular biology. Brain 3.1 (Bm 3.1) is a POU domain homeobox gene involved in the normal development of the vestibular and auditory system. Brn 3.1 deletion results in a loss of hair cells in the otoliths, semicircular canals, and cochlea. As a result mice with a Brn 3.1 deletion do not have a functioning vestibular or auditory system. The BRN 3.1 knockout mouse could be a very useful animal model for isolating the role of the vestibular system in mediating the physiological responses to 2G exposure. Therefore, this study compared the effect of 2G exposure via centrifugation between Brn 3.1 knockout (KO) versus Wildtype (W) mice.

Author

Vestibules; Autonomic Nervous System; Circadian Rhythms; Exposure; Cells (Biology); Gravitational Fields; Losses; Physiological Responses; Semicircular Canals

20000020667 University of North Texas Health Science Center, Dept. of Integrative Physiology, Forth Worth, TX USA

Sleep Restriction Effects on Cardiovascular Regulation

Smith, M. L., University of North Texas Health Science Center, USA; Watenpaugh, D. E., University of North Texas Health Science Center, USA; Muenter, N., University of North Texas Health Science Center, USA; Wasmund, S. L., University of North Texas Health Science Center, USA; Wasmund, W. L., University of North Texas Health Science Center, USA; Carter, R., III, University of North Texas Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 565-566; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our previous studies have demonstrated that 2G exposure via centrifugation significantly attenuated the daily mean and circadian rhythm amplitude of rat body temperature (Th), heart rate, and activity (Act). In addition, 2G exposure activates neural responses in several vestibular, autonomic, and circadian nuclei. Although we have characterized the effect of 2G on an animal's physiological, neuronal, and behavioral responses, it will be important to understand the underlying neural and physiological mechanisms that mediate those responses. For example, the vestibular responses, proprioceptive feedback, or fluid shifts may be the critical factors that mediate the responses to 2G. As a first step to understand the relative importance of these different response pathways to altered gravitational fields, this study examined the contribution of the vestibular system by utilizing an animal model from molecular biology. Brain 3.1 (Bm 3. 1) is a POU domain homeobox gene involved in the normal development of the vestibular and auditory system. Brn 3.1 deletion results in a loss of hair cells in the otoliths, semicircular canals, and cochlea. As a result mice with a Brn 3.1 deletion do not have a functioning vestibular or auditory system. The BRN 3.1 knockout mouse could

be a very useful animal model for isolating the role of the vestibular system in mediating the physiological responses to 2G exposure. Therefore, this study compared the effect of 2G exposure via centrifugation between Bm 3.1 knockout (KO) versus Wildtype (W) mice.
Author
Sleep; Cardiovascular System; Autonomic Nervous System; Cells (Biology); Centrifuging; Circadian Rhythms; Gravitational Fields; Physiological Responses; Semicircular Canals; Vestibules

20000020668 Brigham and Women's Hospital, Circadian, Neuroendocrine and Sleep Disorders Section, Boston, MA USA
Circadian Entrainment, Sleep-Wake Regulation and Neurobehavioral Performance Under the Simulated Lighting Conditions of Long-Duration Space Missions
Wright, K. P., Jr., Brigham and Women's Hospital, USA; Jewett, M. E., Brigham and Women's Hospital, USA; Klerman, E. B., Brigham and Women's Hospital, USA; Kronauer, R. E., Brigham and Women's Hospital, USA; Czeisler, C. A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 567-568; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sustaining high levels of performance throughout extended duration space missions requires: 1) circadian entrainment of the intrinsic longer-than-24-hour period of the human circadian pacemaker to the 24-hour day; 2) maintenance of an appropriate phase relation of the human circadian pacemaker to the sleep-wake schedule. During space exploration, astronauts are likely to be exposed to light-dark cycles that are characterized by either an abnormal period different from the 24.0-hour duration of an Earth day, i.e., the 1.5-hour period of the light-dark cycle during earth orbit and the 24.6-hour period of the light-dark cycle on Mars, or by a light-dark cycle of reduced intensity, i.e., less than 50 lux in the angle of gaze, when the space craft is illuminated artificially and under power constraints. Such light-dark cycles maybe inadequate to maintain the appropriate phase-relation between the scheduled sleep-wake cycle and the circadian system, resulting in circadian misalignment. Such circadian misalignment can result in sleep disturbances, reduced growth hormone secretion, reduced attention, gastrointestinal disorders and impaired daytime alertness. We have undertaken nine 55-day inpatient studies to evaluate: 1) whether entrainment of the human circadian pacemaker will be disturbed in humans when the strength of the environmental light-dark cycle is reduced, resulting in poor sleep and impaired daytime performance; and 2) whether abnormal entrainment to either the 24.0-hour Earth day or the 24.6 hour Mars day will result in disturbed sleep, impaired daytime performance, reduced growth hormone secretion during sleep and inappropriate secretion of the sleep-promoting hormone melatonin during the waking day. to do so, we have used a strict light-dark cycle comparable to that used in entrainment studies of plants and animals. The present report discusses preliminary results from these studies.
Author
Circadian Rhythms; Sleep; Wakes; Neuromuscular Transmission; Astronaut Performance; Cycles; Daytime; Gastrointestinal System; Illuminating; Long Duration Space Flight

20000020669 Massachusetts Inst. of Tech., Cambridge, MA USA
User Friendly Instrumentation for Non-Invasive Assessment of Alterations of Cardiovascular Regulation Associated With Space Flight
Cohen, R. J., Massachusetts Inst. of Tech., USA; Iyengar, N., Massachusetts Inst. of Tech., USA; Mullen, T. J., Harvard Medical School, USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 570-572; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is critically important to be able to assess alterations in cardiovascular regulation during and after space flight. We are presently developing an instrument for the non-invasive assessment of such alterations that can be used on the ground and potentially during space flight. This instrumentation will be used by the Cardiovascular Alterations Team at multiple sites for the study of the effects of space flight on the cardiovascular system and the evaluation of countermeasures. In particular, the Cardiovascular Alterations Team will use this instrumentation in conjunction with ground-based human bed-rest studies and during application of acute stressors (e.g., tilt, exercise) as well as in animal studies. In future studies, the Cardiovascular Alterations Team anticipates using this instrumentation to study astronauts before and after space flight and ultimately, during space flight. The instrumentation may also be used by the Bone Demineralization/Calcium Metabolism Team, the Neurovestibular Team and the Human Performance Factors, Sleep and Chronobiology Team to measure changes in autonomic nervous function. The instrumentation is based on a powerful new technology - cardiovascular system identification (CSI) - which has been developed in our laboratory. CSI provides a non-invasive approach for the study of alterations in cardiovascular regulation. This approach involves the analysis of second-to-second fluctuations in physiologic signals such as heart rate and non- invasively measured arterial blood pressure in order to characterize quantitatively the physiologic mechanisms responsible for the couplings

between these signals. Through the characterization of multiple physiologic mechanisms, CSI provides a closed-loop model of the cardiovascular regulatory state in an individual subject. The application of CSI currently requires off-line computerized analysis of recorded physiologic signals by an expert user. The user operates in an iterative manner with the computer to preprocess the data, select data segments for analysis, run the CSI analyses, and to evaluate and interpret the results. Thus, the availability of this technology is currently limited to highly expert users located in Professor Cohen's laboratory. In this project, we are developing integrated instrumentation capable of acquiring the physiologic signals, performing the CSI analysis in a fully automated fashion, and displaying the results on-line. The design of this instrumentation will be such that users with minimal training (including astronauts and other NSBRI investigators) can perform CSI onsite, conveniently and effectively. The availability of this instrumentation is essential for effectively studying the cardiovascular effects of space flight and for the subsequent development and evaluation of appropriate countermeasures. The development of such instrumentation may also have significant clinical impact on earth in the diagnosis and treatment of patients with a variety of cardiovascular and neurologic disorders.
Author
Cardiovascular System; Autonomic Nervous System; Procedures; Human Performance; On-Line Systems; Sleep; Rhythm (Biology); Physical Exercise; Diagnosis; Countermeasures; Computer Techniques

20000020672 NASA Ames Research Center, Moffett Field, CA USA
Physiological Signal Conditioner
Friedericks, C., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 577; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Sensors 2000! is developing a Physiological Signal Conditioner (PSC) for monitoring of astronauts in the ISS Human Research Facility. The PSC is battery powered and worn by the crew. The Engineering Development Unit (PSC EDU) and the form-and-fit PSC Tooling Model will be displayed along with associated graphics and text explanations. Results of a recent advanced PSC-2 feasibility study will be presented. The presentation will stimulate discussion of the functional capabilities of a wireless, crew worn Physiological Signal Conditioner. Application of advanced technology to meet the conflicting demands of size, power, and functional capability will be of interest.
Author
Product Development; Feasibility; Wireless Communication; Bioinstrumentation

20000020679 Harvard-MIT Div. of Health Sciences and Technology, Cambridge, MA USA
New Techniques for the Non-Invasive Imaging of Tissue Perfusion
Sherman, D. A., Harvard-MIT Div. of Health Sciences and Technology, USA; Rubin, R. H., Harvard-MIT Div. of Health Sciences and Technology, USA; Cohen, R. J., Harvard-MIT Div. of Health Sciences and Technology, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 585; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Non-invasively imaging and quantitative perfusion of tissue by blood is important for both space and civilian medicine. Changes in muscle perfusion may lead to atrophy and subsequent tissue loss. Changes in cerebral perfusion may be linked to motion sickness and altered brain function. Similarly, reduced perfusion of other organs may similarly compromise their function. Little is known about alterations in regional perfusion resulting from space flight because traditional methods for measuring perfusion have relied upon contrast agents injected into the blood stream. Because these agents have a limited half-life, they are not ideal for monitoring long-term changes in tissue perfusion. Alterations in perfusion may be more pronounced in older astronauts and astronauts with pre-existing disease. The development of non-invasive means of assessing regional tissue perfusion would also be of great benefit to diagnosing and treating patients on earth; it would be of particular value in managing patients in the intensive care unit.
Author
Procedures; Imaging Techniques; Tissues (Biology); Muscles; Cerebrum; Motion Sickness; Diffusion

20000020685 NASA Johnson Space Center, Houston, TX USA
Context-Specific Adaptation of Gravity-Dependent Vestibular Reflex Responses (NSBRI Neurovestibular Project 1)
Shelhamer, Mark, Johns Hopkins Univ., USA; Goldberg, Jefim, Baylor Coll. of Medicine, USA; Minor, Lloyd B., Johns Hopkins Univ., USA; Paloski, William H., NASA Johnson Space Center, USA; Young, Laurence R., Massachusetts Inst. of Tech., USA; Zee, David S., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 443-446; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Impairment of gaze and head stabilization reflexes can lead to disorientation and reduced performance in sensorimotor tasks such as piloting of spacecraft. Transitions between different gravitoinertial force (gif) environments - as during different phases of space flight - provide an extreme test of the adaptive capabilities of these mechanisms. We wish to determine to what extent the sensorimotor skills acquired in one gravity environment will transfer to others, and to what extent gravity serves as a context cue for inhibiting such transfer. We use the general approach of adapting a response (saccades, vestibuloocular reflex: VOR, or vestibulocollic reflex: VCR) to a particular change in gain or phase in one gif condition, adapting to a different gain or phase in a second gif condition, and then seeing if gif itself - the context cue - can recall the previously-learned adapted responses. Previous evidence indicates that unless there is specific training to induce context-specificity, reflex adaptation is sequential rather than simultaneous. Various experiments in this project investigate the behavioral properties, neurophysiological basis, and anatomical substrate of context-specific learning, using otolith (gravity) signals as a context cue. In the following, we outline the methods for all experiments in this project, and provide details and results on selected experiments.
Author
Adaptation; Vestibular Tests; Sensorimotor Performance; Reflexes; Otolith Organs; Gravitational Effects; Cues

20000020688 Loma Linda Univ., Radiobiology Program, CA USA
Cooperative Research in Proton Space Radiation
Nelson, G. A., Loma Linda Univ., USA; Slater, J. M., Loma Linda Univ., USA; Archambeau, J. O., Loma Linda Univ., USA; Green, L. M., Loma Linda Univ., USA; Gridley, D. S., Loma Linda Univ., USA; Abell, G. A., Loma Linda Univ., USA; Moyers, M. M., Loma Linda Medical Center, USA; Coutrakon, G. A., Loma Linda Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 513-514; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Loma Linda University and NASA Code UL are participating in a cooperative research agreement whose focus is on the effects of proton radiation on biological systems. Principal elements of this agreement are: 1) development of physics and biology facilities for controlled irradiation of subjects with protons in the energy and dose ranges found in space, 2) facility and personnel support for visiting investigators, and 3) conduct of radiobiology and physics research emphasizing the unique properties of protons. Loma Linda has upgraded its Proton Treatment Center by designing and installing a dedicated beam line that can provide high energy protons for biological investigations. Supporting biological laboratories have been outfitted for investigations with sub.ects ranging from microorganisms and cultured cells to rodents. A visitors' laboratory is maintained exclusively for visiting scientists and radiobiological investigations with protons are now underway.
Author
Research; Bioassay; Extraterrestrial Radiation; Proton Energy; Radiobiology

20000020915 Naval Health Research Center, San Diego, CA USA
Body Composition and Physical Performance: Estimation of Lifting and Carrying from Fat-Free Mass ***Final Report, 1 Jun. - 30 Sep. 1998***
Hodgdon, J. A.; Beckett, M. B.; Oct. 30, 1998; 22p; In English
Report No.(s): AD-A370123; NHRC-98-37; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Services, have, for 16 years, used body composition as the basis for weight control policy. There is a familiarity with the concepts and notions of the nature of body composition within the Services. Body composition variables, specifically fat-free mass and fat mass have been shown to be related to materials handling performances. It is the purpose of this report to determine these relationships, and suggest ways in which they might be used for safe, field deployable methods for estimation of materials handling performance. It appears that fat-free mass can be used to estimate ability to perform manual materials handling tasks. In the case of lifting, logistic models can be used to determine acceptable levels of fat-free mass for specific tasks: lifting heights and weights. In the case of carrying tasks, simplifying principles need to be developed before predictive models can be developed.
DTIC
Aerospace Medicine; Human Body; Physical Fitness; Fats; Body Composition (Biology); Human Performance

53
BEHAVIORAL SCIENCES

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

20000015408 Transportation Safety Associates, Silver Spring, MD USA
Ocular Measures of Driver Alertness: Technical Conference Proceedings
Carroll, R. J.; Sep. 20, 1999; 184p; In English; Ocular Measures of Driver Alertnes, 26-27 Apr. 1999, Herndon, VA, USA
Report No.(s): PB2000-101412; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This report presents the proceedings of a technical conference on ocular measures of driver alertness, sponsored by the Federal Highway Administration (FHWA) Office of Motor Carrier and Highway Safety and the National Highway Traffic Safety Administration (NHTSA) Office of Motor Carrier and Highway Safety and the National Highway Traffic Safety Administration (NHTSA) Office of Vehicle Safety Research. The purpose of this conference was to (1) share recent FHWA/NHTSA findings regarding the validity of eye-based measures of driver alertness, (2) share recent FHWA and NHTSA technology developments in this area, (3) identify and provide information about other Research and Technology studies relevant to in-vehicle alertness monitoring, (4) review the overall state-of-the-art of in-vehicle alertness monitoring, (5) review concepts for feedback of alertness information to drivers and other proposed features of driver-vehicle interface, and (6) review concepts for the successful and user-acceptable introduction of in-vehicle alertness monitoring systems to commerical motor carrier fleets.
NTIS
Conferences; Alertness

20000017960 Tuskegee Inst., Aerospace Science Engineering Dept., AL USA
Team Training and Retention of Skills Acquired Above Real Time Training on a Flight Simulator ***Final Report, 19 Nov. 1997 - 30 Oct. 1999***
Ali, Syed Friasat, Tuskegee Inst., USA; Guckenberger, Dutch, SDS International, Inc., USA; Crane, Peter, Air Force Research Lab., USA; Rossi, Marcia, Tuskegee Inst., USA; Williams, Mayard, Tuskegee Inst., USA; Williams, Jason, Tuskegee Inst., USA; Archer, Matt, SDS International, Inc., USA; January 2000; 26p; In English
Contract(s)/Grant(s): NAG4-133; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Above Real-Time Training (ARTT) is the training acquired on a real time simulator when it is modified to present events at a faster pace than normal. The experiments related to training of pilots performed by NASA engineers (Kolf in 1973, Hoey in 1976) and others (Guckenberger, Crane and their associates in the nineties) have shown that in comparison with the real time training (RTT), ARTT provides the following benefits: increased rate of skill acquisition, reduced simulator and aircraft training time, and more effective training for emergency procedures. Two sets of experiments have been performed; they are reported in professional conferences and the respective papers are included in this report. The retention of effects of ARTT has been studied in the first set of experiments and the use of ARTT as top-off training has been examined in the second set of experiments. In ARTT, the pace of events was 1.5 times the pace in RTT. In both sets of experiments, university students were trained to perform an aerial gunnery task. The training unit was equipped with a joystick and a throttle. The student acted as a nose gunner in a hypothetical two place attack aircraft. The flight simulation software was installed on a Universal Distributed Interactive Simulator platform supplied by ECC International of Orlando, Florida. In the first set of experiments, two training programs RTT or ART7 were used. Students were then tested in real time on more demanding scenarios: either immediately after training or two days later. The effects of ARTT did not decrease over a two day retention interval and ARTT was more time efficient than real time training. Therefore, equal test performance could be achieved with less clock-time spent in the simulator. In the second set of experiments three training programs RTT or ARTT or RARTT, were used. In RTT, students received 36 minutes of real time training. In ARTT, students received 36 minutes of above real time training. In RARTT, students received 18 minutes of real time training and 18 minutes of above real time training as top-off training. Students were then tested in real time on more demanding scenarios. The use of ARTT as top-off training after RTT offered better training than RTT alone or ARTT alone. It is, however, suggested that a similar experiment be conducted on a relatively more complex task with a larger sample of participants. Within the proposed duration of the research effort, the setting up of experiments and trial runs on using ARTT for team training were also scheduled but they could not be accomplished due to extra ordinary challenges faced in developing the required software configuration. Team training is, however, scheduled in a future study sponsored by NASA at Tuskegee University.
Author
Flight Simulation; Training Simulators; Real Time Operation; Computerized Simulation

20000017991 Old Dominion Univ., Research Foundation, Norfolk, VA USA

Biocybernetic Control of Vigilance Task Parameters ***Final Report, Period ending 31 Dec. 1999***

Freeman, Frederick G., Old Dominion Univ., USA; February 2000; 32p; In English

Contract(s)/Grant(s): NAG1-2105

Report No.(s): ODURF-183881; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The major focus of the present proposal was to examine psychophysiological variables that are related to hazardous states of awareness induced by monitoring automated systems. With the increased use of automation in today's work environment, people's roles in the work place are being redefined from that of active participant to one of passive monitor. Although the introduction of automated systems has a number of benefits, there are also a number of disadvantages regarding the worker performance. Byrne and Parasuraman (1996) have argued for the use of psychophysiological measures in both the development and the implementation of adaptive automation. While both performance based and model based adaptive automation have been studied, the use of psychophysiological measures, especially EEG, offers the advantage of real time evaluation of the state of the subject. Previous investigations of the closed-loop adaptive automation system in our laboratory, supported by NASA, have employed a compensatory tracking task which involved the use of a joystick to maintain the position of a cursor in the middle of a video screen. This research demonstrated that, in an adaptive automation, closed-loop environment, subjects perform a tracking task better under a negative, compared to a positive, feedback condition. While tracking is comparable to some aspects of flying an airplane, it does not simulate the environment found in the cockpit of modern commercial airplanes. Since a large part of the flying responsibilities in commercial airplanes is automated, the primary responsibility of pilots is to monitor the automation and to respond when the automation fails. Because failures are relatively rare, pilots often suffer from hazardous states of awareness induced by long term vigilance of the automated system. Consequently, the aim of the current study was to investigate the ability of the closed-loop, adaptive automation system in a vigilance paradigm. It is also important to note that tracking involves a continuous, though low level, motor response. Since it is not clear how such activity might affect performance of the adaptive automation system, it was thought to be important to evaluate how the system functioned when there was minimal motor output by the subjects. The current study used the closed-loop system, developed at NASA-Langley Research Center, to control the state of awareness of subjects while they performed a vigilance task. Several experiments were conducted to examine the use of EEG feedback to control a target dimension used in the task. Changes in a subject's arousal, as defined by specific EEG indexes, produced stimulus changes known to affect task performance. In addition, different electrode sites, compared to previous research, were sampled to determine the optimum configuration with regard to the following criteria: (1) task performance and (2) EEG index.

Derived from text

Automatic Control; Alertness; Biodynamics; Electroencephalography; Feedback Control; Human Performance; Psychophysiology

20000020503 Johns Hopkins Univ., School of Medicine, Baltimore, MD USA

Stability and Precision of Performance During Space Flight

Brady, J. V., Johns Hopkins Univ., USA; Kelly, T. H., Kentucky Univ., USA; Hienz, R. D., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 139-141; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The success of long-term spaceflights with humans depends critically upon the development of a technology that can effectively manage the imposing behavioral and social complexities inherent in such undertakings. Development of an ecosystem to accomplish these objectives will proceed most effectively with an experimentally-derived database focused upon the prediction and functional management of the behavior of individuals. of primary importance is the development of a means for behavioral support during prolonged exposure to confined microsociety environments such as those associated with long-term space travel. Investigations of the performance of small groups over the past two decades have convincingly demonstrated that the consequences of any single individual's behavior is a critical determinant of both individual and group behavior under conditions of prolonged social and cultural isolation. In the course of ground-based laboratory studies, computerized procedures were developed for engendering and maintaining stable measures of a range of complex human behaviors, including cognitive and psychomotor performances, under conditions that require only minimum training. In studies involving continuous performance monitoring, human participants have been shown to work productively and energetically with this computerized task battery over extended time intervals. The stability and sensitivity of the measures generated have made it possible to assess both decrements in and enhancements of performances that are affected by meal macronutrient content, sleep deprivation, medications, and stressful conditions. The demonstrated sensitivity and utility of these procedures for long-term repetitive assessment of the

stability and precision of multiple human behavior dimensions provided the basis for their application to an evaluation of crewmember performance during a space flight mission.
Author
Performance Prediction; Controlled Atmospheres; Environmental Control; Exposure; Human Behavior; Psychomotor Performance; Sleep Deprivation

20000020504 NASA Ames Research Center, Moffett Field, CA USA
Monitoring and Correcting Autonomic Function Aboard Mir: NASA Technology Used in Space and on Earth to Facilitate Adaptation
Cowings, P., NASA Ames Research Center, USA; Toscano, W., California Univ., USA; Taylor, B., Akron Univ., USA; DeRoshia, C., NASA Ames Research Center, USA; Kornilova, L., Institute of Biomedical Problems, USSR; Koslovskaya, I., Institute of Biomedical Problems, USSR; Miller, N., Yale Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 142-144; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The broad objective of the research was to study individual characteristics of human adaptation to long duration spaceflight and possibilities of their correction using autonomic conditioning. The changes in autonomic state during adaptation to microgravity can have profound effects on the operational efficiency of crewmembers and may result in debilitating biomedical symptoms. Ground-based and inflight experiment results showed that certain responses of autonomic nervous system were correlated with, or consistently preceded, reports of performance decrements or the symptoms. Autogenic-Feedback-Training Exercise (AFTE) is a physiological conditioning method that has been used to train people to voluntary control several of their own physiological responses. The specific objectives were: 1) to study human autonomic nervous system (ANS) responses to sustained exposure to microgravity; 2) to study human behavior/performance changes related to physiology; 3) To evaluate the effectiveness of preflight autonomic conditioning (AFTE) for facilitating adaptation to space and readaptation to Earth; and 4) to archive these data for the NASA Life Sciences Data Archive and thereby make this information available to the international scientific community.
Author
Autonomic Nervous System; Adaptation; Space Flight; Physiological Responses; Human Tolerances; Feedback

20000020505 Air Force Research Lab., HEAS, Brooks AFB, TX USA
Cognitive Performance in Seven Shuttle Astronauts
Eddy, D. R., NTI, Inc., USA; Schiflett, S. G., Air Force Research Lab., USA; Schlegel, R. E., Oklahoma Univ., USA; Shehab, R. L., Oklahoma Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 145-147; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The impact of microgravity and other stressors on cognitive performance need to be quantified before long duration space flights are planned or attempted since countermeasures may be required. Two cooperative USAF/NASA experiments were flown aboard Space Shuttle Columbia to investigate cognitive performance in space. One was a part of the payload for the Second International Microgravity Laboratory (IML-2) in July 1994 (STS-65) and the other was aboard the Life and Microgravity Spacelab (LMS) in June 1996 (STS-78). Cognitive performance tests were selected from the DOD Unified Tri-Service Cognitive Performance Assessment Battery (UTC-PAB) to assess the types of skills required of astronauts working on space-based tasks. A Performance Assessment Workstation (PAWS) was developed and validated for space flight to present the tasks and collect the cognitive performance data. The tests measured working memory, spatial processing, directed attention, tracking, and dual task timesharing. The PAWS battery included the following tests: a Mood Scale, Unstable Tracking, Spatial Matrix Rotation, Stemberg Memory Search, Continuous Recognition Memory, Directed Attention--Manikin and Mathematical Processing, Dual Task, and a Fatigue Scale. Complete descriptions of the tests can be found in Schlegel, Shehab, Gilliland, Eddy and Schiflett (1995).
Author
Cognitive Psychology; Human Performance; Spaceborne Experiments; Performance Tests; Mental Performance; Long Duration Space Flight

20000020507 California Univ., San Francisco, CA USA
Interactions of Crewmembers and Mission Control Personnel During Shuttle/MIR Missions
Kanas, N., California Univ., USA; Salnitskiy, V., Institute for Biomedical Problems, Russia; Grund, E., California Univ., USA; Gushin, V., Institute for Biomedical Problems, Russia; Kozerenko, O., Institute for Biomedical Problems, Russia; Marmar, C., California Univ., USA; Sled, A., California Univ., USA; Weiss, D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 150-151; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reports from space and space analog studies on Earth have suggested that interpersonal issues play an important role in how crewmembers relate with one another and with people on the ground during long-duration space missions. These sources, along with our previous work (i.e., a questionnaire study of 54 astronauts and cosmonauts who had flown in space; an investigation of psychosocial factors affecting a three-man crew confined for 135 days in the Mir space station simulator in Moscow), have suggested that crew tension, cohesion, and leadership role are important issues warranting further study in the space environment. We also found evidence to support a biphasic model where psychosocial issues are manifested differently in the 2nd half versus the 1st half of a typical mission involving people secluded together for a long period of time. It is important to study such issues, since interpersonal problems can lead to decreased morale and compatibility, withdrawal and territorial behavior, scapegoating and subgrouping, and disruptive crew-ground communication. This paper will present findings from a four-year NASA-funded study that examined how tension, cohesion, and leadership role affect space crews and members of mission control on Earth and how these factors change over time.
Author
Spacecrews; Simulators; Personnel; Morale; Leadership; Crews; Compatibility

20000020508 NASA Johnson Space Center, Houston, TX USA
Predictors of Behavior and Performance During Long Duration Space Missions: The Antarctic-Space Analog Program (ASAP)
Palinkas, L. A., California Univ., San Diego, USA; Gunderson, E. K. E., Naval Health Research Center, USA; Johnson, J. C., East Carolina Univ., USA; Holland, A. W., NASA Johnson Space Center, USA; Miller, C., California Univ., San Diego, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 152-153; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is generally acknowledged that long duration space missions will require crewmember personality and social characteristics that differ substantially from those required for short duration missions. However, small sample sizes and relatively few long duration missions have made the identification of such characteristics in astronaut personnel somewhat problematic. Studies of personnel in analog environments such as Antarctic research stations allow for a determination of the characteristics of ideal candidates for long duration missions.
Author
Personality; Performance Prediction; Human Behavior; Space Missions

20000020509 Oklahoma Univ., Norman, OK USA
NASA Performance Assessment Workstation: A Tool for Astronaut Cognitive Performance Evaluation
Schlegel, R. E., Oklahoma Univ., USA; Shehab, R. L., Oklahoma Univ., USA; Schiflett, S. G., Armstrong Lab., USA; Eddy, D. R., NTI, Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 154-157; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA Performance Assessment Workstation (PAWS) is a laptop computer-based battery of tasks designed to evaluate astronaut cognitive performance during space flight. The tasks were selected to examine attention shifting, spatial, mathematical, and memory skills, and tracking ability. The subjective scales were selected to assess overall fatigue and mood state. PAWS was flown on the Second International Microgravity Laboratory (IML-2) and the Life and Microgravity Spacelab (LMS) missions to study the combined effects of microgravity and fatigue on cognitive performance. This paper provides a background on the PAWS battery of tasks, including descriptions of the tasks and information on task reliability, stability and learning curves.
Author
Astronaut Performance; Computer Techniques; Evaluation; Mental Performance; Performance Tests

20000020510 Oklahoma Univ., Norman, OK USA
Cognitive Performance Assessment with a Bed Rest Analog for Microgravity
Shehab, R. L., Oklahoma Univ., USA; Schlegel, R. E., Oklahoma Univ., USA; Schiflett, S. G., Armstrong Lab., USA; Eddy, D. R., NTI, Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 158-161; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA Performance Assessment Workstation (PAWS) is a computer-based battery of tasks designed to evaluate astronaut cognitive performance during space flight. Each PAWS session requires subjects to complete six performance tasks and two subjective scales. The tasks were selected to examine attention shifting, spatial, mathematical, and memory skills, and tracking ability. The subjective scales were selected to assess overall fatigue and mood state. PAWS was flown on the Second International Microgravity Laboratory (IML-2) and the Life and Microgravity Spacelab (LMS) missions to study the combined effects of microgravity and fatigue on cognitive performance. The LMS mission assembled twelve experiments designed to

evaluate the impact of space flight on a broad range of human abilities. The experiments examined three general areas: 1) muscle structure and function, 2) metabolism, and 3) performance. The NASA PAWS was included as a performance experiment to evaluate cognitive performance changes during and after flight. One-year prior to the flight of LMS, a bed rest analog was used in a ground-based study to examine the host of proposed life sciences experiments. The bed rest microgravity analog restricts subjects to a prone, 6', head-down posture for the duration of the study. The physiological effects of this postural restriction simulate the physiological effects of a microgravity environment. The bed rest study followed the planned flight schedule and procedures for LMS and served to evaluate the combined sequence of experiments prior to the actual flight. The bed rest study provided the opportunity to identify and resolve conflicts and incompatibilities within the schedule, refine experimental procedures, and optimize proposed timelines. The bed rest study also provided ground-based control group data for comparison with the flight data. As part of the LMS payload, PAWS was included in the LMS bed rest study. This paper details the PAWS bed rest experiment.
Author
Bed Rest; Astronaut Performance; Physiological Effects; Muscular Function; Microgravity; Electric Batteries; Computer Techniques

20000020511 Anacapa Sciences, Inc., Santa Barbara, CA USA
Review and Analysis of Diaries Maintained by the Leaders and Physicians of French Remote Duty Stations
Stuster, J., Anacapa Sciences, Inc., USA; Bachelard, C., Territoire des Terres Australes et Antarctiques Francaises; Suedfeld, P., British Columbia Univ., Canada; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 162-163; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In previous studies of space analogue conditions it has been impossible to support with objective evidence any scheme that attempts to assign relative priority to the many behavioral issues that must be considered when designing procedures and equipment for long duration isolation and confinement. Psychologist, Peter Suedfeld, voiced the concern of behavioral scientists and perplexed aerospace managers when he commented that a particular study "...does not communicate judgments about the relative importance of the various problems, so the reader is often left wondering about what design or preparation or intervention goals should have priority if one has to make choices--as one often does because of restrictions of time, space, payload capacity, personnel, funds, and so forth." Using data derived from the experiences of actual leaders and physicians during expeditions in remote, isolated, and hostile environments, the current study identifies the major categories of behavioral issues associated with isolation and confinement, and provides quantitative data on which to base judgments concerning the relative importance of the categories and their constituent themes.
Author
Analogs; Expeditions; Isolation; Spacecrews

20000020512 NASA Johnson Space Center, Houston, TX USA
Psychological Adaptation to Extreme Environments: Effects of Team Composition on Individual Adaptation
Wood, J., Baylor Coll. of Medicine, USA; Hysong, S. J., Rice Univ., USA; Lugg, D. J., Australian Antarctic Div.; Harm, D. L., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 164-165; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study is part of an ongoing program of research examining the psychological effects of isolation and confinement on individual adaptation, productivity and group relations in Antarctic winter personnel. This environment is used as an analogue for long-duration space mission scenarios, such as a space station sojourn, or a mission to Mars. Earlier results from this and other environments have demonstrated that: (1) most changes in psychological well-being are event-related and of relatively short duration; and (2) the greatest problem facing most individuals is interpersonal conflict. Content analysis of responses to open-ended questions has identified the numerous enjoyable aspects of Antarctic living, and confirmed that many of the problems reported were interpersonal in nature, and that problems varied significantly by station. Current work is exploring the effects of team assignment on the self-reported psychological changes and self-evaluations of members of isolated teams. This work includes identifying the dimensions by which subjects determine how well they are functioning. These dimensions (e.g., work, social life, internal emotional state) appear to play an important role in how subjects evaluate many aspects of life in isolation.
Author
Psychological Effects; Adaptation; Emotional Factors; Isolation; Group Dynamics

20000020513 Wisconsin Univ., Madison, WI USA

Mission Control Information Flow Issues

Caldwell, Barrett S., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 167-169; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA funded research project, "Control-Crew Network Communication During Routine and Non-Routine Events: Effects on Mission Control-Crew Performance," has only been active since May, 1998. However, the current research is also able to draw on prior work conducted in the PI's research group since 1995. Much of this related research has significant impacts on several biomedical and human performance assessment topics, especially in the area of task coordination and performance enhancement in cognitively demanding tasks. This presentation will provide a brief overview of past studies, outline of the current research, and plans for future investigations from this early research perspective. One human performance concern in supervisory control tasks is the interaction of changes in task demands (workload transitions) and cycles of operator alertness during system monitoring or supervisory system management. The combination of sudden workload transitions with lowered alertness can result in hazardous states of awareness, which may significantly impair the operator's ability to respond effectively to a degraded situation or environmental condition. Hazardous states of awareness can present problems both for mission control console operators, and the astronaut crews themselves, depending on phase of flight and the need for coordinated information flow and task performance. In order to reduce potential performance degradation associated with hazardous states of awareness, research effort has been devoted to identify physiological or behavioral correlates of reduced alertness associated with reduced task performance. Two studies conducted in the PI's Group Performance (GROUPER) research group have addressed the impact of workload transitions on operators at varying states of alertness as measured by EEG and EKG data. One study, conducted at SPAWAR in San Diego, evaluated operators in a air defense task over 96 person-hours (N= 1 2, four two-hour task sessions over two days) of varying alertness. The second study, conducted at the Sleep Research Center at UW- Madison, evaluated performance in a NASA MATB resource management task after a period of low task demands, collecting approximately 50 person-hours (N approx. 100, one 30-minute session) of data. Analysis of both data sets is ongoing. However, initial results from the SPAWAR study indicated that variations in alertness in the single minute prior to workload transitions could significantly predict variance in task performance during the 5-7 minute high task demand phase following the transition. Initial results of the Sleep Research Center study indicated that persons with serious measured sleep apneas were significantly more impaired in their performance responses to a workload transition after a period of low task demands. The results of these studies clearly indicate that effective information flow regarding operator alertness, as well as increased task coordination support during workload transitions, will be of importance in managing distributed supervisory control task performance between mission control operators and astronaut crews. The current research does not examine operator alertness variables, but focuses instead on the changes in communication patterns associated with routine and non-routine events. Both types of events may represent workload transitions from the crew and mission control, and many require new techniques for adaptive bandwidth allocation to support mission success.

Derived from text

Active Control; Mission Planning; Information Flow; Human Performance; Resources Management; Electroencephalography; Electrocardiography

20000020515 EEG Systems Lab., San Francisco, CA USA

Neurophysiological Indices of Sustained Focused Attention: Application to Monitoring Cognitive Load, Operational Fatigue, and Other Environmental Stressors

Gevins, Alan, EEG Systems Lab., USA; Smith, Michael E., EEG Systems Lab., USA; McEvoy, Linda, EEG Systems Lab., USA; Brown, Halle, EEG Systems Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 173-174; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In complex work environments, any cognitive overload imposed by high task demands can lead to performance errors and inefficiencies in the acquisition of new procedures. Similarly, personnel who are experiencing a transient cognitive impairment (because of fatigue or sleep loss, illness or medication, intoxication or hangover, etc.) may be error prone in situations that tax the limits of their reduced mental capacity. Such conditions have frequently been implicated in major accidents. Neurophysiological (EEG) measures can provide sensitive indices of an individual's ability to focus and sustain attention and to hold information in working memory. We are evaluating the feasibility of using such measures of brain function to detect changes in cognitive status associated with environmental stressors. Preliminary studies provided initial evidence that multivariate combinations of task-related EEG variables can provide sensitive indices of cognitive load and transient cognitive impairment. Our current NASA-sponsored effort aims to further verify and extend these results.

Author

Mental Performance; Neurophysiology; Electroencephalography; Monitors

20000020518 NASA Johnson Space Center, Houston, TX USA

Evaluations of Three Methods for Remote Training

Woolford, B., NASA Johnson Space Center, USA; Chmielewski, C., Lockheed Martin Corp., USA; Pandya, A., Lockheed Martin Corp., USA; Adolf, J., Lockheed Martin Corp., USA; Whitmore, M., Lockheed Martin Corp., USA; Berman, A., Lockheed Martin Corp., USA; Maida, J., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 182-183; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long duration space missions require a change in training methods and technologies. For Shuttle missions, crew members could train for all the planned procedures, and carry documentation of planned procedures for a variety of contingencies. As International Space Station (ISS) missions of three months or longer are carried out, many more tasks will need to be performed for which little or no training was received prior to launch. Eventually, exploration missions will last several years, and communications with Earth will have long time delays or be impossible at times. This series of three studies was performed to identify the advantages and disadvantages of three types of training for self-instruction: video-conferencing; multimedia; and virtual reality. These studies each compared two types of training methods, on two different types of tasks. In two of the studies, the subject's were in an isolated, confined environment analogous to space flight; the third study was performed in a laboratory. Author

Evaluation; Training Analysis; Education; Space Missions; Time Lag

20000020606 Legacy Good Samaritan Hospital, Neurotology Research, Portland, OR USA

Roll-Tilt Perception Using a Somatosensory Bar Task

Black, F. O., Legacy Good Samaritan Hospital, USA; Wade, S. W., Legacy Good Samaritan Hospital, USA; Arshi, A., Legacy Good Samaritan Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 409-410; In English

Contract(s)/Grant(s): NAGW-3799; NIH-R01-DC-00205; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Visual estimates of roll-tilt perception during static roll-tilt are confounded by an offset due to the ocular counterroll that simultaneously occurs. An alternative, non-visual ('somatosensory') measure of roll-tilt perception was developed which is not contaminated by this offset. The aims of this study were to determine: 1) inter-subject variability of somatosensory settings across test session in normal subjects and patients with unilateral or bilateral vestibular loss and 2) intra-subject variability of settings across test session in normal subjects.

Author

Vestibules; Sensory Perception; Losses; Contamination

20000020616 Washington Univ., Dept. of Otolaryngology, Seattle, WA USA

Self-Motion Perception: Assessment by Real-Time Computer Generated Animations

Parker, Donald E., Washington Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 435-436; In English

Contract(s)/Grant(s): NAG5-4074; NAG9-958; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our overall goal is to develop materials and procedures for assessing vestibular contributions to spatial cognition. The specific objective of the research described in this paper is to evaluate computer-generated animations as potential tools for studying self-orientation and self-motion perception. Specific questions addressed in this study included the following. First, does a non-verbal perceptual reporting procedure using real-time animations improve assessment of spatial orientation? Are reports reliable? Second, do reports confirm expectations based on stimuli to vestibular apparatus? Third, can reliable reports be obtained when self-motion description vocabulary training is omitted?

Author

Motion Sickness; Motion Perception; Real Time Operation; Vestibules; Procedures

20000020617 Oregon Health Sciences Univ., Neurological Sciences Inst., Portland, OR USA

Evidence for a Rapid Gain Change Mechanism that Regulates Human Postural Control Dynamics

Peterka, R. J., Oregon Health Sciences Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 437-440; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

An upright stance position is inherently unstable. A small body sway deviation from a perfect upright position results in a torque due to gravity that accelerates the body farther away from the upright position. to maintain upright stance, the destabilizing torque due to gravity must be countered by corrective torque exerted by the feet against the support surface. This corrective torque is most likely generated through the action of a feedback control system. That is, body motion away from upright is detected by sensory systems, the motion information is processed by the CNS, and the processed signals are used to generate corrective torques

that move the body back toward the upright position. The visual, proprioceptive, and vestibular systems are the primary sensory systems contributing to postural control. However, altered environmental conditions can eliminate or compromise the accuracy of sensory information. Examples include: (1) eye closure or darkness that eliminates visual orientation cues, (2) soft or compliant surfaces that alter proprioceptive information related to the feet and ankle joint motion, and (3) altered vestibular cues due to space-flight induced adaptive changes in the interpretation of vestibular sensory information.
Derived from text
Central Nervous System; Cues; Data Processing; Dynamic Characteristics; Eye (Anatomy); Feedback Control; Gravitation; Physiological Responses; Simulation; Vestibules; Visual Stimuli

20000020618 NASA Johnson Space Center, Houston, TX USA
Visual-Vestibular Responses During Space Flight
Reschke, M. F., NASA Johnson Space Center, USA; Kozlovskaya, I. B., Institute of Biomedical Problems, USSR; Paloski, W. H., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 441-442; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Given the documented disruptions that occur in spatial orientation during space flight and the putative sensory-motor information underlying eye and head spatial coding, the primary purpose of this paper is to examine components of the target acquisition system in subjects free to make head and eye movements in three dimensional space both during and following adaptation to long duration space flight. It is also our intention to suggest a simple model of adaptation that has components in common with cerebellar disorders whose neurobiological substrate has been identified.
Author
Vestibules; Visual Stimuli; Attitude (Inclination); Head Movement; Sensorimotor Performance

20000020917 Naval Postgraduate School, Monterey, CA USA
Scheduling Aircrew Training at USA Navy Fleet Readiness Squadron HC-3 During Replacements of H-46D Helicopters by CH-60S
Jasperson, Kevin S.; Sep. 1999; 66p; In English
Report No.(s): AD-A370143; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The USA Navy is replacing the H-46D helicopter with the new CH-60S helicopter. Helicopter Combat Support Squadron Three (HC-3) is the US Navy's Fleet Readiness Squadron, responsible for training the contingent of pilots and aircrewmen to fly this helicopter fleet; it is also responsible for managing their transition to the CH-60S. Each pilot and aircrewman represents a large investment in training and experience, and each is engaged in some stage of a Navy career that is governed by a host of guidelines for training, service experience, sea and shore duty rotations, and so forth. This thesis introduces an optimization model that takes as input the current state of Navy pilots and aircrewmen, the schedule of CH-60S introductions, restrictions on career duty tours and qualifying experience, limits on training resources, and other policy guidelines. The output is a schedule of duty tours, including training, retraining, shore, and sea duty tours, while recommending an optimal set of career paths to accommodate the transition over an 84-month period.
DTIC
Scheduling; Pilot Training

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..

20000019594 Specialized Analysis Engineering, Inc., Franklin, TN USA
A Highly Damped, High-Strength, Puncture-Resistant Fabric for Multi-Threat Protective Uniforms, Phase 1 ***Final Report, 5 May - 4 Dec. 1998***
Paine, Jeffrey S.; Tretiakova, Irina V.; Aug. 1999; 56p; In English
Contract(s)/Grant(s): DAAN02-98-P-8547
Report No.(s): AD-A371636; NITIOSD-120498-RP; NATICK-TR-99/040; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The Phase I project was very successful in demonstrating the feasibility of using a superelastic Nitinol shape memory alloy to improve cut, tear, and puncture resistance of military Battle Dress Uniform (BDU) fabric. The Nitinol reinforcement increased

cut-resistance by 20 times and tear resistance by 2.5 times the values for current BDU fabric. Cotton/Nylon plain weave fabrics were fabricated in small lots with excellent quality for testing. Various reinforcements were added to demonstrate enhanced mechanical performance. The force-displacement tensile curves from the Modified Grab Test results show that the addition of Nitinol to the fabric doesn't significantly alter flexibility level. The fabrics experienced a 50 to 60 percent increase in breaking strength over the plain fabric with the 5 and 10 Nitinol fibers per inch. Calculations of areal density do not show significant difference between reinforced fabric and plain fabric. Fabric does not kink unless subjected to very severe loads. Wrinkles cannot develop because the shape memory effect returns the Nitinol reinforcement to original shape. Nitinol provides an electrical conduit in the uniform that minimizes shock and static discharge. The Phase I effort has positively demonstrated the feasibility of gaining improved protection in textiles without sacrificing fabric flexibility.
DTIC
Fabrics; Piercing; Protective Clothing; Damping

20000019632 Monterey Technologies, Inc., Los Gatos, CA USA
Crew Fatigue and Performance on U.S. Coast Guard Cutters ***Final Report***
Miller, James C., Monterey Technologies, Inc., USA; October 1998; 150p; In English
Contract(s)/Grant(s): DTRS-57-93-D-0095; Proj. 3302.04.02
Report No.(s): AD-A366708; CG-D-10-99; R&DC-31-99; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

This report describes an analysis of crew workload and fatigue on Coast Guard cutters. Descriptive measures were obtained on five cutters of three types under normal operations. Evidence of mild fatigue, specifically daytime sleepiness and a degradation of vigilance performance, was observed in many crew members. This study documented levels of workload, performance, and fatigue found in normal, daily Coast Guard cutter operations. Principles of industrial chronohygiene were considered in light of the analysis of crew member sleep patterns, circadian rhythms, and watch schedules. This analysis led to recommendations for watch schedule alternatives that may reduce the probability of crew daytime sleepiness and vigilance performance degradation.
Author
Crews; Fatigue (Biology); Human Factors Engineering; Ships; Human Performance

20000020500 Air Force Research Lab., HEPR, Brooks AFB, TX USA
Staged Decompression to a 3.5 PSI EVA Suit Using An Argon-Oxygen (ARGOX) Breathing Mixture
Pilmanis, A. A.; Krause, K. M.; Webb, J. T.; Petropoulos, L. J.; Kannan, N.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 124-126; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long-term NASA goals include permanent occupation of the International Space Station (ISS) and missions to both the moon and Mars. One of the critical issues for reaching these goals is the definition of an optimum pressure for extravehicular activity (EVA) suits. Currently, a 4.3 psia pressure suit is used for space shuttle EVAS. This suit, in combination with current preoxygenation schedules, is effective for decompression sickness (DCS) prevention. However, at 4.3 psia, the astronauts experience hand and arm fatigue. Also, due to the gravitational forces that exist on the moon and Mars, the current suit will be too heavy for planetary EVA. A 100% oxygen breathing gas at an ambient pressure of 2.8 psia, is physiologically equivalent to breathing air at 10,000 feet altitude. However, because there will be some minimal performance decrement from mild hypoxia at that pressure and to provide a margin of safety, we propose a lower limit for the suit pressure of 3.5 psia. A soft, lower pressure suit requires a trade-off between preoxygenation time and suit weight and mobility. Development of a new 3.5 psia EVA pressure suit would reduce structural complexity, leak rate, and weight while increasing mobility, comfort, and maintainability. The trade-off for these advantages will be an increase in decompression time.
Derived from text
Decompression Sickness; Argon; Oxygen Breathing; Extravehicular Activity; Breathing Apparatus; Gas Mixtures; Pressure Gradients; Pressure Suits; Safety

20000020502 Duke Univ., Hypo/Hyperbaric Center, Durham, NC USA
An Understanding of Decompression Physiology Leads to Safer and More Efficient ExtraVehicular Activity (EVA)
Vann, R. D., Duke Univ., USA; Gerth, W. A., Duke Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 132-134; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Extravehicular activity (EVA) in the U.S. space program requires decompression from a sea level cabin pressure to an oxygen-filled space suit with a pressure equivalent to an altitude of 30,000 feet. Immediate decompression to this altitude would result in incapacitating or fatal DCS from the formation of nitrogen bubbles in blood and tissue. to avoid this problem, astronauts breathe oxygen at sea level or remain at an intermediate decompression stage of 10,000 feet to eliminate dissolved tissue nitrogen prior to further decompression for EVA. In ground-based EVA simulations, the DCS incidence has been 20-30% pain and 2-3%

chokes or cerebral symptoms. This is despite breathing oxygen at sea level for 3.5-4 hours or remaining at 10,000 feet for 12 hours. Results from mathematical simulations of decompression are in agreement with these tests and indicate that a 12-hour decompression stage at 10.2 psia is inadequate to avoid significant DCS risk. DCS has not been reported during actual Shuttle EVAS, on the other hand, but these operations generally stayed at 10,000 feet for longer than one day (mean 37.8 hrs in 59 EVAs from Shuttle through February 1996). Such procedures are too long for construction of the International Space Station (ISS) where fast and frequent EVA will be required. A solution to this practical problem was found as a direct result of studies that addressed the fundamental mechanisms of decompression sickness.
Author
Decompression Sickness; Physiological Factors; Extravehicular Activity; Signs and Symptoms; Pressure Reduction

20000020514 NASA Johnson Space Center, Houston, TX USA
Microgravity Workstation and Restraint Evaluations
Chmielewski, C., Lockheed Martin Corp., USA; Whitmore, M., Lockheed Martin Corp., USA; Mount, F., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 170-172; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Confined workstations, where the operator has limited visibility and physical access to the work area, may cause prolonged periods of unnatural posture. Impacts on performance, in terms of fatigue and posture, may occur especially if the task is tedious and repetitive or requires static muscle loading. The glovebox design is a good example of the confined workstation concept. Within the scope of the 'Microgravity Workstation and Restraint Evaluation' project, funded by the NASA Headquarters Life Sciences Division, it was proposed to conduct a series of evaluations in ground, KC-135 and Shuttle environments to investigate the human factors issues concerning confined/unique workstations, such as gloveboxes, and also including crew restraint requirements. As part of the proposed integrated evaluations, two Shuttle Detailed Supplementary Objectives (DSOs) were manifested; one on Space Transportation System (STS)-90 and one on STS-88. The DSO on STS-90 evaluated use of the General Purpose Workstation (GPWS). The STS-88 mission was planned to evaluate a restraint system at the Remote Manipulator System (RMS). In addition, KC- 1 35 flights were conducted to investigate user/workstation/restraint integration for long-duration microgravity use. The scope of these evaluations included workstations and restraints to be utilized in the ISS environment, but also incorporated other workstations/ restraints in an attempt to provide findings/requirements with broader applications across multiple programs (e.g., Shuttle, ISS, and future Lunar-Mars programs). In addition, a comprehensive electronic questionnaire has been prepared and is under review by the Astronaut Office which will compile crewmembers' lessons learned information concerning glovebox and restraint use following their missions. These evaluations were intended to be complementary and were coordinated with hardware developers, users (crewmembers), and researchers. This report is intended to provide a summary of the findings from each of the evaluations.
Author
Microgravity; Human Factors Engineering; Life Sciences; Muscles; Physical Work; Posture; Remote Manipulator System; Visibility

20000020516 Pennsylvania Univ., Dept. of Computer and Information Science, Philadelphia, PA USA
Noninvasive Motion Capture and Analysis
Metaxas, Dimitris, Pennsylvania Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 176-178; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Noninvasive computer-vision methods have begun to play an increasingly important role in applications like anthropometry, human factors design, ergonomics, teleconferencing, virtual reality and performance measurement of both athletes and patients with psychomotor disabilities. All of these areas require the identification of the parts of a human body and/or the estimation of their shape and motion parameters. The main difficulties in developing algorithms for human shape and motion analysis stem from the complex 3D no-n-rigid motions of humans and the occlusion among body parts. The solution to the above problems requires the development of an algorithm that: (1) integrates the processes of segmentation and fitting, (2) allows reliable shape description of the parts, (3) estimates the true location of the joints between the parts, (4) detects multiple joints, (5) copes with the problem of occlusion, (6) makes no assumptions of a prior model or part segmentation, and (7) obviates the need for markers and special equipment. We have developed physics-based vision techniques for the development of algorithms to automatically capture human motion from multiple single and multiple cameras. Using the captured data we can analyze the motions of humans during a variety of applications.
Author
Algorithms; Anthropometry; Computer Vision; Human Factors Engineering; Psychomotor Performance; Virtual Reality

20000020517 NASA Langley Research Center, Hampton, VA USA

Measuring Astronaut Performance in Microgravity: Loads and Modeling

Newman, D., Massachusetts Inst. of Tech., USA; Beck, S., NASA Langley Research Center, USA; Amir, A., Massachusetts Inst. of Tech., USA; Baroni, G., Politecnico di Milano, Italy; Ferrigno, G., Politecnico di Milano, Italy; Pedotti, A., Politecnico di Milano, Italy; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 179-181; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Quantitative analysis of human performance in microgravity is important for both scientific investigations and spacecraft engineering design. By collecting and evaluating the kinematics and kinetics data of astronauts in space, it becomes possible to characterize human motor strategies, postural behavior in weightlessness, improve the design of orbital modules, help maintain a quiescent microgravity for acceleration-sensitive material science and life science experiments (NASA JSC, 1996), and optimize the human operative capabilities during long-duration space missions. Hence, there is a need for a precise measurement of the forces and moments exerted by the astronauts on the space station and their postures and movements.

Author

Astronaut Performance; Human Behavior; Human Performance; Microgravity; Long Duration Space Flight; Quantitative Analysis

20000020551 NASA Ames Research Center, Moffett Field, CA USA

Exercise Training During +Gz Acceleration

Greenleaf, J. E., NASA Ames Research Center, USA; Chou, J. L., Lockheed Martin Corp., USA; Simonson, S. R., Lockheed Martin Corp., USA; Jackson, C. G. R., Fresno State Univ., USA; Barnes, P. R., San Francisco State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 278; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The overall purpose is to study the effect of passive (without exercise) and active (with exercise) +Gz (head-to-foot) acceleration training, using a short-arm (1.9m radius) centrifuge, on post- training maximal oxygen uptake (VO2 max, work capacity) and 70 deg head-up tilt (orthostatic) tolerance in ambulatory subjects to test the hypothesis that (a) both passive and active acceleration training will improve post-training tilt-tolerance, and (b) there will be no difference in tilt-tolerance between passive and active exercise acceleration training because increased hydrostatic and blood pressures, rather than increased muscular metabolism, will provide the major adaptive stimulus. The purpose of the pilot study was to test the hypothesis that there would be no significant difference in the metabolic responses (oxygen uptake, heart rate, pulmonary ventilation, or respiratory exchange ratio) during supine exercise with moderate +Gz acceleration.

Author

Attitude (Inclination); Blood Pressure; Respiratory Physiology; Physical Exercise; Physiological Responses; Heart Rate

20000020563 University of North Texas Health Science Center, Forth Worth, TX USA

Carotid Baroreflex Function During Prolonged Exercise

Raven, P. B., University of North Texas Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 305-307; In English

Contract(s)/Grant(s): NAG5-4668; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Astronauts are often required to work (exercise) at moderate to high intensities for extended periods while performing extra-vehicular activities (EVA). Although the physiologic responses associated with prolonged exercise have been documented, the mechanisms involved in blood pressure regulation under these conditions have not yet been fully elucidated. An understanding of this issue is pertinent to the ability of humans to perform work in microgravity and complies with the emphasis of NASA's Space Physiology and Countermeasures Program. Prolonged exercise at a constant workload is know to result in a progressive decrease in mean arterial pressure (MAP) concomitant with a decrease in stroke volume and a compensatory increase in heart rate. The continuous decrease in MAP during the exercise, which is related to the thermoregulatory redistribution of circulating blood volume to the cutaneous circulation, raises the question as to whether there is a loss of baroreflex regulation of arterial blood pressure. We propose that with prolongation of the exercise to 60 minutes, progressive increases on central command reflect a progressive upward resetting of the carotid baroreflex (CBR) such that the operating point of the CBR is shifted to a pressure below the threshold of the reflex rendering it ineffectual in correcting the downward drift in MAP. In order to test this hypothesis, experiments have been designed to uncouple the global hemodynamic response to prolonged exercise from the central command mediated response via: (1) continuous maintenance of cardiac filling volume by intravenous infusion of a dextran solution; and (2) whole body surface cooling to counteract thermoregulatory cutaneous vasodialation. As the type of work (exercise) performed by astronauts is inherently arm and upper body dependent, we will also examine the physiologic responses to prolonged leg

cycling and arm ergometry exercise in the supine positions with and without level lower body negative pressure (-10 torr) to mimic spaceflight- related decreases in cardiac filling volumes.
Author
Arteries; Blood Circulation; Blood Pressure; Countermeasures; Heart Rate; Lower Body Negative Pressure; Microgravity; Physical Exercise; Stroke Volume

20000020573 Houston Univ., TX USA
Microbial Monitoring Technology for Long Duration Space Flights
Fox, George E., Houston Univ., USA; Wibbenmeyer, Jamie, Houston Univ., USA; Larios-Sanz, Maia, Houston Univ., USA; Kourentzi, Katerina, Houston Univ., USA; Murphy, Jason C., Houston Univ., USA; Willson, Richard C., Houston Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 335; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Crew health is a dominant issue in space flight. As mission duration and resupply intervals increase it is essential to be able to effectively monitor air and water supplies for gradual or acute buildup of microorganisms. We are developing methods that will allow simultaneous monitoring for multiple bacterial types in space environments.
Author
Health; Long Duration Space Flight; Monitors; Microorganisms

20000020579 NASA Johnson Space Center, Houston, TX USA
Analysis of MIR Condensate and Potable Water
Pierre, L. M., Wyle Labs., Inc., USA; Bobe, L., NIICHIMMASH; Protasov, N. N., RSC-Energia; Sauer, R. L., NASA Johnson Space Center, USA; Schultz, J. R., Wyle Labs., Inc., USA; Sinyak, Y. E., Institute of Biomedical Problems, USSR; Skuratov, V. M., Institute of Biomedical Problems, USSR; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 345-347; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or processed fuel cell water transferred from the Shuttle. Reclamation of water for potable and hygiene purposes is considered essential for extended duration missions in order to avoid massive costs associated with resupplying water from the ground. The Joint U.S/Russian Phase 1 program provided the U.S. the first opportunity to evaluate the performance of water reclamation hardware in microgravity. During the Phase I program, the U.S. collected recycled water, stored water, and humidity condensate samples for chemical and microbial evaluation. This experiment was conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems, and to aid in developing water quality monitoring standards for International Space Station.
Author
Condensates; Ground Water; Hygiene; Microorganisms; Potable Liquids; Potable Water; Water Quality

20000020594 NASA Johnson Space Center, Houston, TX USA
CO2 Accumulation in the Non-Conformal Helmet of the NASA Launch and Entry Suit During Simulated Unaided Egress
Greenisen, M. C., NASA Johnson Space Center, USA; Bishop, P. A., Alabama Univ., USA; Lee, S. M. C., Wyle Labs., Inc., USA; Moore, A., Wyle Labs., Inc., USA; Williams, J., Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 377; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Launch and Entry Suit (LES) has been worn by astronauts since 1988 for Space Shuttle launch and landing. Previous work indicated that carbon dioxide (CO2) accumulation in the LES non-conformal helmet might be high during locomotion while wearing the LES. The purpose of this study was to characterize the inspired CO2%, metabolic requirements, and egress performance during a simulation of an unaided egress from the Space Shuttle in healthy male subjects wearing the LES and walking on a treadmill. With the helmet visor closed, 12 male subjects completed a 6-min seated prebreathe with 100% O2 followed by a 2-min stand and 5 min of walking at 1.56 m/sec (5.6 km/h, 3.5 mph) as a simulation of unaided egress. All subjects walked with four different G-suit pressures (0.0, 0.5, 1.0, 1.5 psi). After a 10-min recovery, subjects walked 5 min with the same G-suit pressure and helmet visor open for the measurement of metabolic rate (VO2). When G-suit inflation levels were 1.0 or 1.5 psi, only 4 of our 12 healthy, non-micro-gravity exposed subjects completed the unaided egress. Inspired CO2 levels greater than 4% were routinely observed during walking. The metabolic cost at the 1.5 psi G-suit inflation was over 135% of the metabolic cost at 0.0 psi inflation. During unaided egress, G-suit inflation pressures of 1.0 (required inflation for missions greater than 11

days) and 1.5 psi resulted in elevated CO2 in the LES helmet and increased metabolic cost of walking, either of which could impact unaided egress by returning space flight crews.
Author
Carbon Dioxide; Accumulations; Helmets; Metabolism; Microgravity; Simulation

20000020621 NASA Johnson Space Center, Houston, TX USA
Nutrition Session Summary
Lane, Helen, NASA Johnson Space Center, USA; Stein, T. P., Medicine and Dentistry Univ. of New Jersey, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 452-454; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Nutrition deficiencies affect multiple systems including muscle, bone, cardiovascular, renal, and gastrointestinal. Humans require many nutrients, ranging from the macronutrients (water, protein, energy sources) to micronutrients (minerals, vitamins). The ability to withstand shortfalls in intake of individual nutrients ranges from one or two days (e.g., water) to weeks (energy, protein, potassium) and months (some vitamins, minerals). In addition to putting humans at risk for nutrition deficiencies, space flight may also change the absorption, hence the pharmacodynamics, of several important medications. Papers given in this session dealt with all of these nutritional and pharmacological factors related to space flight: (1) Protein metabolism and muscle formation. (2) Pharmacodynamics. (3) Calcium metabolism and bone formation/resorption. and (4) Fluid and electrolytes.
Author
Nutrition; Bone Demineralization; Calcium Metabolism; Vitamins; Proteins; Potassium; Minerals; Electrolytes

20000020624 Cornell Univ., Dept. of Agricultural and Biological Engineering, Ithaca, NY USA
Food System Challenges for Long-Duration Space Missions
Hunter, Jean B., Cornell Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 459-460; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

On long-duration manned space missions food is at once a key habitability issue, a biomedical issue, and an issue of engineering and systems design . As mission duration increases, a bioregenerative lifesupport system becomes more cost-effective than the physico-chemical regeneration systems now used on Shuttle and ISS; however, bioregenerative life support requires growing and processing of in-situ grown crops, treatment of food wastes, and preparation of daily meals, all within severe labor constraints. Though plant production for space missions has been extensively studied, space-compatible technologies for processing crops and preparing ready to eat foods have yet to be developed. These processing and preparation problems constitute a major engineering challenge for food systems in space. The goal of our project is to develop an expandable database of food processing information and a user-friendly optimization system to support informed decisions regarding food processing and preparation for long-duration space missions. We are developing a "bioregenerative cuisine" of 200+ nutritious and appealing dishes that an astronaut crew can prepare and eat during a long- duration mission. This large number is required to provide future crews with a range of dietary choices, and to allow mission management to optimize the menu for closure, labor costs, or other constraints. The dishes include both familiar and novel menu items. Each food is evaluated for palatability, nutrient content and preparation cost in terms of equivalent system mass. The project includes the following components: Development and testing of foods (recipes) intended for a bioregenerative lifesupport system with around 90% food closure. Currently, at the halfway point of the project, around 120 recipes have been tested, with another 120 to be developed. Estimation of labor and equipment costs of food ingredient manufacture from CELSS crops and of food preparation from these ingredients. Our current spreadsheet models predict the portion of food costs traceable to energy, cooling, processing equipment, and non-renewable resources. Labor costs, the most challenging to predict and to scale, are now under study. Evaluation of the acceptability of a chiefly plant-based diet to an omnivorous population, through a 30-day closed feeding study near the end of the project Nutritional analysis of individual foods and ingredients, ongoing with their development Linear programming optimization of the diet to arrive at low-cost diets satisfying given constraints on nutrient content, labor requirements and acceptability of the overall menu. to date we have performed "proof of concept" optimizations and are now working on larger scale runs and sensitivity analyses to predict the marginal cost of food quality, variety, and other habitability criteria for the menu.
Derived from text
Acceptability; Diets; Eating; Food Processing; Long Duration Space Flight; Regeneration (Physiology)

20000020625 NASA Johnson Space Center, Houston, TX USA
Fluid and Electrolyte Nutrition
Lane, Helen W., NASA Johnson Space Center, USA; Smith, Scott M., NASA Johnson Space Center, USA; Leach, Carolyn S., NASA Johnson Space Center, USA; Rice, Barbara L., Enterprise Advisory Services, Inc., USA; Proceedings of the First Biennial

Space Biomedical Investigators' Workshop; 1999, pp. 461; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Studies of fluid and electrolyte homeostasis have been completed since the early human space flight programs, with comprehensive research completed on the Spacelab Life Sciences missions SLS-1 and SLS-2 flights, and more recently on the Mir 18 mission. This work documented the known shifts in fluids, the decrease in total blood volume, and indications of reduced thirst. Data from these flights was used to evaluate the nutritional needs for water, sodium, and potassium. Interpretations of the data are confounded by the inadequate energy intakes routinely observed during space flight. This in turn results in reduced fluid intake, as food provides approximately 70% water intake. Subsequently, body weight, lean body mass, total body water, and total body potassium may decrease. Given these issues, there is evidence to support a minimum required water intake of 2 L per day. Data from previous Shuttle flights indicated that water intake is 2285 +/- 715 ml/day (mean +/- SD, n=26). There are no indications that sodium intake or homeostasis is compromised during space flight. The normal or low aldosterone and urinary sodium levels suggest adequate sodium intake (4047 +/- 902 mg/day, n=26). Because excessive sodium intake is associated with hypercalciuria, the recommended maximum amount of sodium intake during flight is 3500 mg/day (i.e., similar to the Recommended Dietary Allowance, RDA). Potassium metabolism appears to be more complex. Data indicate loss of body potassium related to muscle atrophy and low dietary intake (2407 +/- 548 mg/day, n=26). Although possibly related to measurement error, the elevations in blood potassium suggest alterations in potassium homeostasis. The space RDA for minimum potassium intake is 3500 mg/day. With the documented inadequate intakes, efforts are being made to increase dietary consumption of potassium.

Author

Fluid Dynamics; Electrolytes; Research; Blood Volume; Body Fluids; Homeostasis; Losses; Nutrition

20000020670 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Wireless Augmented Reality Prototype (WARP)

Devereaux, A. S., Jet Propulsion Lab., California Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 573-575; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Initiated in January, 1997, under NASA's Office of Life and Microgravity Sciences and Applications, the Wireless Augmented Reality Prototype (WARP) is a means to leverage recent advances in communications, displays, imaging sensors, biosensors, voice recognition and microelectronics to develop a hands-free, tetherless system capable of real-time personal display and control of computer system resources. Using WARP, an astronaut may efficiently operate and monitor any computer-controllable activity inside or outside the vehicle or station. The WARP concept is a lightweight, unobtrusive heads-up display with a wireless wearable control unit. Connectivity to the external system is achieved through a high-rate radio link from the WARP personal unit to a base station unit installed into any system PC. The radio link has been specially engineered to operate within the high- interference, high-multipath environment of a space shuttle or space station module. Through this virtual terminal, the astronaut will be able to view and manipulate imagery, text or video, using voice commands to control the terminal operations. WARP's hands-free access to computer-based instruction texts, diagrams and checklists replaces juggling manuals and clipboards, and tetherless computer system access allows free motion throughout a cabin while monitoring and operating equipment.

Derived from text

Wireless Communication; Prototypes; Voice Control; Product Development; Fabrication; Bioinstrumentation; Head-Up Displays; Imaging Techniques; Real Time Operation

20000020684 NASA Johnson Space Center, Houston, TX USA

An EVA Suit Fatigue, Strength, and Reach Model

Maida, James C., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 175; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The number of Extra-Vehicular Activities (EVAs) performed will increase dramatically with the upcoming Space Station assembly missions. It is estimated that up to 900 EVA hours may be required to assemble the Space Station with an additional 200 hours per year for maintenance requirements. Efficient modeling tools will be essential to assist in planning these EVAS. Important components include strength and fatigue parameters, multi-body dynamics and kinematics. This project is focused on building a model of the EVA crew member encompassing all these capabilities. Phase 1, which is currently underway, involves collecting EMU suited and unsuited fatigue, strength and range of motion data, for all major joints of the body. Phase 2 involves processing the data for model input, formulating comparisons between the EMU suits and deriving generalized relationships between suited and unsuited data. Phase 3 will be formulation of a multi-body dynamics model of the EMU capable of predicting mass handling properties and integration of empirical data into the model. Phase 4 will be validation of the model with collected

EMU data from the Neutral Buoyancy Laboratory at NASA/JSC. Engineers and designers will use tie EVA suit database to better understand the capabilities of the suited individuals. This knowledge will lead to better design of tools and planned operations. Mission planners can use the modeling system and view the animations and the visualizations of the various parameters, such as overall fatigue, motion, timelines, reach, and strength to streamline the timing, duration, task arrangement, personnel and overall efficiency of the EVA tasks. Suit designers can use quantifiable data at common biomechanical structure points to better analyze and compare suit performance.
Author
Extravehicular Activity; Fatigue (Biology); Biodynamics; Data Structures; Predictions; Muscular Strength

20000020999 Biodynamic Research Corp., San Antonio, TX USA
A Personal Computer-Based Head-Spine Model ***Final Report, May 1996 - Sep. 1998***
Pancratz, David J., Biodynamic Research Corp., USA; Rogers, Linda J., Biodynamic Research Corp., USA; Bomar, John B., Jr., Biodynamic Research Corp., USA; Sep. 1998; 151p; In English
Contract(s)/Grant(s): F41624-95-C-6010; AF Proj. 3005
Report No.(s): AD-A370895; AFRL-HE-WP-TR-1999-0175; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy
The Head-Spine Model (HSM) originally developed for the UNIX environment was recoded for the personal computer. This recode included code improvements and bug fixes, as well as the development of a graphical interface for creating simulations. The HSM can be used to predict the forces and motions of a human spinal column. The vertebrae are modeled with rigid bodies while hydrodynamic elements model the intevertebral discs. A full set of ligamenteous and active muscular models is also incorporated. External accelerations can be applied to the system and the resulting response calculated. A novel method of calculating an initial equilibrium position was incorporated. Several simulations of frontal and vertical accelerations were conducted to demonstrate the utility of the software. Along with the HSM, a database of spinal element properties was created. This database can be separately used from the software to determine mass, material, and geometric properties of the spinal elements as derived from a variety of sources in the literature.
DTIC
Computer Programs; Human-Computer Interface; Head (Anatomy); Spine; Computer Techniques

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL

20000014454 Department of Education, Office of Educational Research and Improvement, Washington, DC USA
Attaining Excellence: TIMSS as a Starting Point to Examine Mathematics Assessments. In-Depth Look at Geometry and Algebra
Mullis, I. S.; Jones, C. O.; Kelly, D. L.; Martin, M. O.; Jun. 1999; 128p; In English
Report No.(s): PB2000-101100; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
This module presents information about the grade 8 mathematics assessments conducted by the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS). In particular, the first section of the mathematics assessment module compares the frameworks underlying the NAEP and TIMSS grade 8 mathematics assessments and the distribution of test questions across content areas, focusing on the areas of geometry and algebra. The second and third sections of the module describe the geometry and algebra portions of the assessments in detail using actual test questions (often called items) from NAEP and TIMSS assessments to illustrate how areas of the frameworks became operationalized into test questions. The assessment results are provided for the geometry and algebra questions to provide some perspective about US performance in these two mathematics content areas.
NTIS
Algebra; Education; Geometry

20000020757 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
Bounds for Maps of an Interval with One Critical Point of Inflection Type II
Levin, Genadi, Institut des Hautes Etudes Scientifiques, France; vanStrien, Sebastian, Institut des Hautes Etudes Scientifiques, France; Oct. 1999; 68p; In English
Report No.(s): PB2000-102529; IHES/M/99/82; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

In this paper the authors prove complex bounds, quasisymmetric rigidity, absence of invariant linefields and density of hyperbolicity for real analytic maps with one reflecting critical point which are orientation preserving on each branch. For real bounds, see the first part of this paper.
NTIS
Maps; Points (Mathematics); Critical Point

20000020897 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
On the Homotopy Invariance of Higher Signatures for Manifolds with Boundary
Leichtnam, E.; Lott, J.; Piazza, P.; Jul. 1999; 44p; In English
Report No.(s): PB2000-100760; IHES/M/99/49; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
If M is a closed oriented manifold-with-boundary whose fundamental group is virtually nilpotent or Gromov-hyperbolic, the authors show that the higher signatures of M are oriented-homotopy invariants.
NTIS
Manifolds (Mathematics); Homotopy Theory; Invariance; Signatures; Boundaries

20000020898 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
Gromov-Witten Invariants and Rigidity of Hamiltonian Loops with Compact Support on Noncompact Symplectic Manifolds
Lu, G.; Jun. 1999; 52p; In English
Report No.(s): PB2000-100756; IHES/M/99/43-Rev; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
In this paper the Gromov-Witten invariants on a class of noncompact symplectic manifolds are defined by combining Ruan-Tian's method with that of McDuff-Salamon. The main point of the arguments is to introduce a method dealing with the transversality problems in the case of noncompact manifolds. Moreover, the techniques are also used to study the topological rigidity of Hamiltonian loops with compact support on a class of noncompact symplectic manifolds.
NTIS
Hamiltonian Functions; Manifolds (Mathematics); Loops

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.

20000015402 California Univ., Dept. of Materials Science and Engineering, Los Angeles, CA USA
New Quantum Dot Waveguides for Nonlinear Optical Applications (An AASERT Award) ***Final Report, 1 Jul. 1995-30 Sep. 1999***
Mackenzie, John D.; Aug. 01, 1999; 19p; In English
Contract(s)/Grant(s): F49620-95-1-0471
Report No.(s): AD-A371392; AFRL-SR-BL-TR-99-0288; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Three female graduate students who are all U.S. citizens have been supported by this grant. During the past few years, this collaborative project had resulted in the preparation of CdS optical discs with the highest X(3) recorded and the successful fabrication of these highest X(3) recorded and the successful fabrication of these materials into waveguides. That research had also created an environment in which students could be trained not only as materials scientists but, with the exposure to the activities of the Arizona Optical Sciences Center, simultaneously as new materials based device fabricators. In the future, such trained students will be invaluable in rapid exploitation of new materials and technology transfer in the field of photonics. Quantum dot samples based on CdS and their fabrication into waveguides had been successfully accomplished. (1) We proposed to adopt the same technique, that is the SOL-GEL technique, to prepare other quantum dot samples based on METAL CLUSTERS, e.g., silver and CdTe. Metal cluster quantum dots have very high X(3), and (2) Their containment in an oxide glass matrix and their fabrication into waveguides have not been reported. Theoretically, however, CdTe quantum dots should have higher values of X(3) than CdS. We had proposed to study both metal clusters and CdTe if support was available for our students. Originally, the present ASSERT award was made for one student only. We therefore decided to conduct research on CdTe only. The plan was to use sodium borosilicate glass as a matrix as for the CdS quantum dot samples. Firstly, the sol-gel method enabled us to make

dense glasses at the relatively low temperatures of 500-550 deg C. Secondly, a sodium containing glass would permit ion exchange with potassium ions in a molten salt bath and thus lead to the fabrication of waveguides.
DTIC
Optical Waveguides; Quantum Dots; Fabrication; Borosilicate Glass; Photonics; Technology Transfer

20000020744 Naval Postgraduate School, Monterey, CA USA
Quantum Computers and Their Impact on DoD in the 21st Century
Mades, John E.; Sep. 1999; 83p; In English
Report No.(s): AD-A371045; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Computer processor speeds double every eighteen months according to Moore's law. This growth will reach a limit by the year 2020. Quantum computation is one proposed alternative to bypass this limitation. This thesis explores the topic of quantum computation. Specifically, we address what is a quantum computer, its various proposed implementations, its technological feasibility, and its military applications. Recent experiments have provided a proof of concept for quantum computation and some researchers believe that a working model could be developed within a reasonable time period. This success has caused a marked increase in the interest in quantum computers and their proposed potential. We attempt to separate fact from fiction to see what possible benefits the Department of Defense could obtain from it.
DTIC
Microprocessors; Quantum Theory; Architecture (Computers); Computers

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.

20000014373 NASA Ames Research Center, Moffett Field, CA USA
Improvements to the Unstructured Mesh Generator MESH3D
Thomas, Scott D., Raytheon ITSS, USA; Baker, Timothy J., Princeton Univ., USA; Cliff, Susan E., NASA Ames Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 213-252; In English; See also 20000014369; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The AIRPLANE process starts with an aircraft geometry stored in a CAD system. The surface is modeled with a mesh of triangles and then the flow solver produces pressures at surface points which may be integrated to find forces and moments. The biggest advantage is that the grid generation bottleneck of the CFD process is eliminated when an unstructured tetrahedral mesh is used. MESH3D is the key to turning around the first analysis of a CAD geometry in days instead of weeks. The flow solver part of AIRPLANE has proven to be robust and accurate over a decade of use at NASA. It has been extensively validated with experimental data and compares well with other Euler flow solvers. AIRPLANE has been applied to all the HSR geometries treated at Ames over the course of the HSR program in order to verify the accuracy of other flow solvers. The unstructured approach makes handling complete and complex geometries very simple because only the surface of the aircraft needs to be discretized, i.e. covered with triangles. The volume mesh is created automatically by MESH3D. AIRPLANE runs well on multiple platforms. Vectorization on the Cray Y-MP is reasonable for a code that uses indirect addressing. Massively parallel computers such as the IBM SP2, SGI Origin 2000, and the Cray T3E have been used with an MPI version of the flow solver and the code scales very well on these systems. AIRPLANE can run on a desktop computer as well. AIRPLANE has a future. The unstructured technologies developed as part of the HSR program are now targeting high Reynolds number viscous flow simulation. The pacing item in this effort is Navier-Stokes mesh generation.
Derived from text
Grid Generation (Mathematics); Applications Programs (Computers); Computational Fluid Dynamics; Unstructured Grids (Mathematics); Engine Airframe Integration

20000014434 National Inst. of Standards and Technology, Information Technology Lab., Gaithersburg, MD USA
Efficiency Testing of ANSI C Implementations of Round 1 Candidate Algorithms for the Advanced Encryption Standard
Bassham, Lawrence E., III, National Inst. of Standards and Technology, USA; October 1999; 14p; In English
Report No.(s): PB2000-100137; NISTIR-6391; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This paper describes the testing methodology used in ANSI C efficiency testing, along with observations regarding the resulting measurements. Conclusions are provided regarding which algorithms have the most consistent performance across

different platforms. This paper also includes an appendix containing tables of timing and cycle counting values obtained from testing the algorithms. Some knowledge regarding compilation and processor architectures is useful in understanding how the data was derived. However, the raw data in the document can also be useful without necessarily understanding how it was derived. Derived from text

Algorithms; Computer Programs; Computer Programming; C (Programming Language)

20000017935 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Approximation and Optimization of an Auditory Model for Realization in VLSI Hardware

SanGregory, Samuel L.; Aug. 1999; 154p; In English

Report No.(s): AD-A371265; AFIT/DS/ENG/99-07; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The Auditory Image Model (AIM) is a software tool set developed to functionally model the role of the ear in the human hearing process. AIM includes detailed filter equations for the major functional portions of the ear. Currently, AIM is mn on a workstation and requires 10 to 100 times real-time to process audio information and produce an auditory image. An all-digital approximation of the AIM which is suitable for implementation in very large scale integrated circuits is presented. This document details the mathematical models of AIM and the approximations and optimizations used to simplify the filtering and signal processing accomplished by AIM. Included are the details of an efficient multi-rate architecture designed for sub-micron VLSI technology to carry out the approximated equations. Finally, simulation results which indicate that the architecture, when implemented in 0.8jtm CMOS VLSI, will sustain real- time operation on a 32 channel system are included. The same tests also indicate that the chip will be approximately 3.3 mm2, and consume approximately 18 mW. The details of a new and efficient method for computing an approximate logarithm (base two) on binary integers is also presented. The approximate logarithm algorithm is used to convert sound energy into millibels quickly and with low power. Additionally, the algorithm, is easily extended to compute an approximate logarithm in base ten which broadens the class of problems to which it may be applied. DTIC

Software Engineering; Digital Systems; Ear; Optimization; Very Large Scale Integration; Mathematical Models

20000017946 Hawaii Univ., Dept. of Electrical Engineering, Manoa, HI USA

Tail Biting Trellis Representation of Codes: Decoding and Construction

Shao. Rose Y., Hawaii Univ., USA; Lin, Shu, Hawaii Univ., USA; Fossorier, Marc, Hawaii Univ., USA; Dec. 16, 1999; 51p; In English

Contract(s)/Grant(s): NAG5-8414; NSF NCR-94-15374; NSF CCR-97-32959; NSF CCR-98-14054

Report No.(s): Rept-99-003; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper presents two new iterative algorithms for decoding linear codes based on their tail biting trellises, one is unidirectional and the other is bidirectional. Both algorithms are computationally efficient and achieves virtually optimum error performance with a small number of decoding iterations. They outperform all the previous suboptimal decoding algorithms. The bidirectional algorithm also reduces decoding delay. Also presented in the paper is a method for constructing tail biting trellises for linear block codes.

Author

Algorithms; Applications Programs (Computers); Trellis Coding; Mathematical Models; Viterbi Decoders; Computerized Simulation

20000019593 University of Southern California, Center for Software Engineering, Los Angeles, CA USA

KBSA Life Cycle Evaluation, Volume 2 ***Final Report, Sep. 1996 - Aug. 1998***

Boehm, Barry; Brown, A. Winsor; Bose, Prasanta; Oct. 1999; 159p; In English

Contract(s)/Grant(s): F30602-96-C-0274; AF Proj. 5581

Report No.(s): AD-A371622; AFRL-IF-RS-TR-1999-225-V2; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

The objective of this research effort was to develop and validate technical approaches for evaluating the effects of Knowledge Based Software Assistant (KBSA) and Evolutionary Design of Complex Software (EDCS) process concepts and technology on software development effort and schedule, and to use these technical approaches to perform comparative evaluations of technology. The approach taken for this research included four tasks. The first was to characterize sources of software technology in the context of recent and emerging software trends. The second was to develop models and an evaluation framework providing a baseline for assessing the effects of software technology on software development effort and schedule. The third task used these models to evaluate KBSA, EDCS and commercial technology with respect to the baseline. The fourth task formulated conclusions and recommendations based upon the results of the study. The report is divided into two volumes because of its length. The first

volume documents the study and summarizes the data and results. The second volume provides additional detail on the models and the evaluations performed.
DTIC
Life (Durability); Software Engineering; Software Development Tools; Computer Aided Design

20000019625 Space and Naval Warfare Systems Center, San Diego, CA USA
Effect of Complementary Processing on Navy Command and Control Software
Oct. 1999; 3p; In English
Report No.(s): AD-A371124; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
Complementary Processing (CP), is a scheduling methodology to increase software execution speed. Experiments were performed to test CP with command and control software, specifically, to measure the effect of CP on the speed of processing Navy track-message data. A 37.5-fold increase was observed in the preliminary test. Recommendations for future tests are discussed.
DTIC
Command and Control; Data Processing; Computer Program Integrity

20000019678 General Accounting Office, Accounting and Information Management Div., Washington, DC USA
Year 2000 Computing Crisis: Avoiding Major Disruptions Will Require Strong Leadership and Effective Partnerships. Statement of Joel C. Willemssen, Director, Civil Agencies Information Systems, Accounting and Information Management Division
Aug. 19, 1998; 24p; In English
Report No.(s): PB2000-101845; GAO/T-AIMD-98-267; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
I will briefly discuss the Year 2000 risks facing the nation, highlight our major concerns with the federal government's progress in correcting its systems, identify state and local government Year 2000 issues, and discuss critical year 2000 data exchange issues.
NTIS
Governments; Computer Programming; File Maintenance (Computers); Checkout; Software Engineering

20000020554 Massachusetts Inst. of Tech., Cambridge, MA USA
Computational Models of the Cardiovascular System and its Response to Microgravity
Heldt, Thomas, Massachusetts Inst. of Tech., USA; Shim, Eun B., Massachusetts Inst. of Tech., USA; Mark, Roger G., Massachusetts Inst. of Tech., USA; Kamm, Roger D., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 283-285; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
The primary objective of this project is to develop a general, modular model of cardiovascular function that contains the essential features associated with the effects of gravity, and to use this model to investigate the short term response to orthostatic stress in normal and micro-gravity adapted cardiovascular systems. The model provides an intellectual framework with which to interpret experimental observations and to evaluate alternative physiologic hypotheses of the cause of orthostatic intolerance. Furthermore, the model can potentially guide the development of screening methods that might be used to identify individuals who are at high risk of developing orthostatic intolerance.
Author
Mathematical Models; Cardiovascular System; Microgravity; Stress (Biology)

20000020772 University of Southern California, Center for Software Engineering, Los Angeles, CA USA
KBSA Life Cycle Evaluation, Volume 1 ***Final Report, Sep. 1996 - Aug. 1998***
Boehm, Barry; Brown, A. Winsor; Bose, Prasanta; Oct. 1999; 55p; In English
Contract(s)/Grant(s): F30602-96-C-0274; AF Proj. 5581
Report No.(s): AD-A371623; AFRL-IF-RS-TR-1999-225-V1; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy
The objective of this research effort was to develop and validate technical approaches for evaluating the effects of Knowledge Based Software Assistant (KBSA) and Evolutionary Design of Complex Software (EDCS) process concepts and technology on software development effort and schedule, and to use these technical approaches to perform comparative evaluations of technology. The approach taken for this research included four tasks. The first was to characterize sources of software technology in the context of recent and emerging software trends. The second was to develop models and an evaluation framework providing a baseline for assessing the effects of software technology on software development effort and schedule. The third task used these models to evaluate KBSA, EDCS and commercial technology with respect to the baseline. The fourth task formulated conclusions

and recommendations based upon the results of the study. The report is divided into two volumes because of its length. The first volume documents the study and summarizes the data and results. The second volume provides additional detail on the models and the evaluations performed.
DTIC
Software Engineering; Knowledge Based Systems; Life (Durability); Computer Programming; Software Development Tools; Computer Aided Design

20000020968 Central Lab. of the Research Councils, Daresbury Lab., Warrington, UK
Requirements for a Data Management Infrastructure to Support UK High-End Computing
Kleese, K., Central Lab. of the Research Councils, UK; Nov. 1999; 74p; In English
Report No.(s): PB2000-102523; DL-TR-99-004; Copyright; Avail: Issuing Activity

In June 1998, CLRC - Daresbury Laboratory started a new project called DAMP - the Data Management in Climate Research Project. The project is concerned with data management requirements of climate researchers and environmental scientists using high performance computing for their research work. During the last year, the work has focused on analyzing the current situation in the UK in the context of developments in other European countries and the USA. More importantly, future strategies have been developed to address the shortcomings identified during the analysis. Though the project was mainly concerned with environmental science and climate research it also considers the needs of other computational science disciplines and the report points out whenever results are of a more general value.
NTIS
Requirements; Data Management

20000020989 Microelectronics and Computer Technology Corp., Austin, TX USA
The Complex Event Detection and Monitoring System ***Final Report, Jun. 1997 - Mar. 1999***
Baker, Donald; Cassandra, Anthony R.; Rashid, Mosfeq; Jul. 1999; 66p; In English
Contract(s)/Grant(s): F30602-97-C-0214; AF Proj. TCOM
Report No.(s): AD-A368935; AFRL-IF-RS-TR-1999-150; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The Composite Event Detection and Monitoring System (CEDMOS) addresses a need for a general, domain independent event processing technology. CEDMOS recognizes patterns of events called complex events according to user authored event specifications. CEDMOS is a general event processing technology that includes: (1) a core infrastructure for event detection which implements a general, efficient event processing mode; (2) a graphical programming environment for the creation and manipulation of composite event specifications; (3) a detector generator, which takes composite event specifications and generates Java(TM) code to recognize the specified composite events; (4) agent shells for rapid development of customized agents for event gathering, composite event detection, and dissemination of composite events. CEDMOS was developed for DARPA by the Microelectronics and Computer Technology Corporation (MCC). This paper gives the theoretical basis for the CEDMOS event processing model. The model is a restriction of a more general event processing model that into consideration a number of practical issues. In addition, issues that arose in the deployment of CEDMOS to some particular domains are discussed. Unlike many other event processing technologies, CEDMOS is not tied to databases or other technologies and can be applied to many different domains.
DTIC
Software Engineering; Data Systems; Data Management; Computer Systems Design; Events

20000021028 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Refining VHDL Specifications Through Conformance Testing: Case Study of an Adaptive Computing Architecture
Duale, Ali Y.; McClure, Bruce D.; Uyar, M. Umit; Jul. 1999; 45p; In English
Report No.(s): AD-A369013; ARL-TR-2010; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The aim of this work is to enable a more rigorously tested product by integrating protocol specification and conformance test sequence generation. Such an integration will allow for the removal of costly mistakes from a specification at an early stage of the development process before they propagate into different implementations, possibly combined with other errors. This integrated approach has been applied to the VHDL specification of a military-oriented protocol prototype called the ”Local Proxy.” Based on the results of the conformance test generation process, the Local Proxy specification has been refined by uncovering various missing actions, removing redundancies, and restructuring the specification to improve its testability.
DTIC
Hardware Description Languages; Refining; Architecture (Computers)

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.

20000017930 Analex Corp., Brook Park, OH USA
ISINT Performance Validation Test Report ***Final Report***
Richard, Alan M., Analex Corp., USA; December 1999; 18p; In English
Contract(s)/Grant(s): NAS3-27600; RTOP 632-50-5A
Report No.(s): NASA/CR-1999-209407; NAS 1.26:209407; E-11935; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Satellite Networks and Architectures branch is researching the application of standard Internet technologies over satellite communication links to LEO spacecraft. The In-Space Internet Testbed (ISINT) simulates this communications path through the use of two experimental subnets of workstations communicating over the Advanced Communications Technology Satellite (ACTS) proof-of-concept radio frequency testbed. In order to validate the end-to-end performance of ISINT, similar file transfers were sent over the RF testbed and over an actual ACTS T1 link. Comparison of the results shows that the ISINT facility has very similar performance to communications over ACTS. This test was only for a stationary point-to-point, bent pipe communications link. ISINT will be configured for more complex links now that point-to-point performance has been validated.
Author
Performance Tests; Satellite Communication; Satellite Networks; Communication Networks; Protocol (Computers); Data Links; Internets

20000019590 Naval Postgraduate School, Monterey, CA USA
The SAAM Architecture: Enabling Integrated Services
Vrable, Dean J.; Yarger, John W.; Sep. 1999; 429p; In English
Report No.(s): AD-A371295; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

Computer networks of today are based predominantly on the TCP/IP protocol suite that provides best effort service. The current IP protocol excels in its simplicity and network fault tolerance. The way it implements this simplicity and fault tolerance, however, limits the protocol's ability to provide a guaranteed Quality of Service (QoS). A first Step in providing this QoS is to incorporate the concept of flow based routing. This thesis describes an implementation of the Server and Agent based Active network Management (SAAM) system architecture that incorporates flow based routing. The architecture contains servers that maintain a database that is used for assigning each flow to a path that will provide the needed QoS.
DTIC
Client Server Systems; Topology; Network Synthesis

20000019618 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Export Controls: Statutory Reporting Requirements for Computers Not Fully Addressed
Nov. 1999; 32p; In English; Report to Congressional Requesters.
Report No.(s): AD-A370947; GAO/NSIAD-00-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. government controls the export of high performance computers to certain countries based on foreign policy and national security concerns. The Commerce Department considers a high performance computer to be one that exceeds a defined performance threshold, thus requiring an export license. In a July 1999 report, the executive branch described its plans to change the controls on the exports of high performance computers by increasing the level of computing performance for which export licenses would be required. The executive branch last modified controls on high performance computers in January 1996. In the Fiscal Year 1998 National Defense Authorization Act (P.L. 105-85, sec. 1211, Nov. 1997), Congress required the executive branch to provide a report justifying proposed changes to export controls on computers. The act requires the report, at a minimum, to (1) address the extent to which high performance computers with capabilities between the established level and the new proposed level of performance are available from other countries, (2) address all potential uses of military significance to which high performance computers at the new levels could be applied, and (3) assess the impact of potential military uses on U.S. national security interests.
DTIC
International Trade; Commerce; Congressional Reports; Computers

20000020756 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK

People and Computers. Proceedings of the Joint International Computers Limited

Randell, B., Editor, Newcastle-upon-Tyne Univ., UK; 1999; 276p; In English, 6-10 Sep. 1999, Newcastle upon Tyne, UK

Report No.(s): PB2000-102535; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Contents include the following: Foreword; An Outline of Social Informatics-The Program of Rationality in Computing (Additional slides provided: The End of Babbage's Theology); New Services and their Challenges--Challenges for the Middleware; Illustrative Risks to the Public in the Use of Computer Systems and Related Technology; The Last Piece of the Puzzle: Bringing Interactive System Design into the Engineering Fold; Programs, Processes, People, Perspectives and What is Informatics; Engineering the Information Age--The Last Five Years: The Emerging Information Infrastructure and Society; Engineering the Information Age--Where Next: Information Utilities and Information Appliances; Learning and the Transition to an Information Society--Implications for HE of an Information Society; and Discussions.

NTIS

Social Factors; Systems Engineering; Conferences; Human-Computer Interface

20000020770 Key Software, Inc., Ithaca, NY USA

Adaptable Dependable Wrappers ***Final Report, Sep. 1996 - Jun. 1999***

Webber, Franklin; Oct. 1999; 78p; In English

Contract(s)/Grant(s): F30602-96-C-0355; AF Proj. E017

Report No.(s): AD-A371510; AFRL-IF-RS-TR-1999-223; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

The objective of the Adaptable Dependable Wrappers effort was to design and implement tools that facilitate the creation of specialized wrappers for software components of a distributed system. The affordable upgrading of systems requires better technology than currently available to support evolutionary adaptation through incremental change. Support is needed for distributed systems so that incremental changes may be applied routinely and inexpensively. This support must allow: incorporation of new code into running systems and diffusion of new code throughout distributed subsystems; automatic analysis of new code to identify its worst case behavior and interference with existing code; fine grained control over privilege given to new code; protocols to coordinate the diffusion of new code; replacement of protocol layers without disruption to processing in other protocol layers; and protocols to tolerate and adapt to subsystem failures. Much of the technology needed for evolutionary computing can be localized in software wrappers. Software wrappers are often used to glue existing subsystems into a larger system with new properties and functions. A wrapper is a software layer used to change the interface of a component or to give new properties, such as fault tolerance or security to the interaction between components. by changing the wrappers, component interfaces can be changed to allow new connections between components. Properties can be changed to satisfy new requirements. These changes permit much of the flexibility that evolutionary computer systems need. This report describes an investigation into tools which support the creations of such wrappers.

DTIC

Distributed Processing; Software Development Tools

20000020939 Naval Postgraduate School, Monterey, CA USA

Special Operations Mission Planning and Analysis Support System

Hattes, Keith A., Naval Postgraduate School, USA; Jun. 1999; 152p; In English

Report No.(s): AD-A370854; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

Current mission preparation and analysis methods place an undue burden of effort on conventional and special operations forces to effectively synchronize and execute their increasingly complex operational responsibilities in a rapidly changing global environment. This thesis developed a tool for the USA Special Operations Command (USSOCOM) in support of their Mission Planning, Analysis, Rehearsal, and Execution (MPARE) initiative to allow special operations forces commanders and staffs to conduct mission planning and analysis in a distributed environment, and rapidly produce dynamic synchronization matrices and scheduling products. Operations research methods provide the foundation for the analysis. The system developed in this thesis is called the Special Operations Mission Planning and Analysis Support System (SOMPASS). SOMPASS is simple to learn and operate, provides dynamic changes with little effort, and is universal in application. This system has the capability to execute on any hardware platform, operate across any network connection, and expand easily to support additional users and requirements. This thesis provides not only a demonstration of capabilities through a special operations oriented illustrative scenario, but also a working product that can be adapted for use in mission planning and analysis by all units under USSOCOM.

DTIC

Mission Planning; Support Systems; Operations Research

20000021014 Department of Defense, Office of Inspector General, Arlington, VA USA
Year 2000 Compliance of Selected Air Mobility Command Systems
Apr. 13, 1999; 17p; In English
Contract(s)/Grant(s): Proj. 9CC-0086.01
Report No.(s): AD-A367048; IG/DOD-99-134; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This is one in a series of reports being issued by the Inspector General, DoD, in accordance with an informal partnership with the Chief Information Officer, DoD, to monitor efforts to address the year 2000 computing challenge. For a listing of audit projects addressing the issue, see the year 2000 webpage on the IGnet at www.ignet.gov. The overall audit objective was to assess the status of selected Military Department and Defense Agency mission-critical systems, identified by U.S. Pacific Command and U.S. Forces Korea as being of particular importance to them, in attaining compliance with year 2000 conversion requirements. Specifically, we reviewed the progress of each system towards year 2000 compliance, testing and integration of modifications, and contingency plans. For this report, we reviewed two Air Mobility Command managed systems, the Command and Control Information Processing System and the Global Air Transportation Execution System, operated within the U.S. Pacific Command area of responsibility.
DTIC
Air Transportation; Information Systems; Systems Management; Computer Program Integrity

20000021015 Department of Defense, Office of Inspector General, Arlington, VA USA
Year 2000 Issues Within U.S. European Command and its Service Components
Apr. 30, 1999; 70p; In English
Contract(s)/Grant(s): Proj. 8LG-5039.01
Report No.(s): AD-A367073; IG/DOD-99-145; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This is a follow-on audit to the Army Audit Agency Memorandum Report No. AA 98-292, ”U.S. European Command’s Management of the Year 2000,” July 30, 1998. The overall audit objective was to evaluate the ability of the U.S. European Command to resolve year 2000 issues to avoid undue disruption of its mission.
DTIC
Systems Management; Information Systems; Planning

20000021074 Nichols Research Corp., Huntsville, AL USA
Multiprocessor Station (MIPS) ***Final Report, Apr. 1996 - Jan. 1999***
Bass, Jaye; Oct. 1999; 39p; In English
Contract(s)/Grant(s): F30602-96-C-0083; AF Proj. 3480
Report No.(s): AD-A371524; AFRL-IF-RS-TR-1999-235; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The objective of the MultiProcessor Station (MIPS) effort was to establish a software development environment to: maximize cross platform portability of image and video processing software; maximize the utilization of available multiprocessors on intelligence workstations; and maximize the life span and minimize the life cycle cost of software. The end product is: an object based visual programming environment in which image and video data and operations are represented by icons; an environment which permits mixing of legacy code and new development; a framework providing the capability to visually program new algorithms without writing any source code; tight integration of the constructor mode with the main window mode means that new algorithms can be developed and easily installed on any computer with MIPS software; the image cube object, which is used to store all imagery and video, makes it possible for all image processing algorithms to be applied to all types of data; versatility for exploiters of multi-spectral imagery, in that processing and display of image bands can be tightly controlled, easily modified, and packaged for widespread use; the environment demonstrates portability across platforms, software reusability, adaptability to various multiprocessor configurations, and extensibility to other application areas (i.e. signal processing).
DTIC
Multiprocessing (Computers); Software Engineering; Computer Programming

20000021076 Synectics Corp., Rome, NY USA
Optical Memory Application Study ***Final Report, Mar. 1996 - Mar. 1998***
Riolo, Joseph J.; Wilson, James R.; Oct. 1999; 71p; In English
Contract(s)/Grant(s): F30602-96-C-0051; AF Proj. 3192
Report No.(s): AD-A371491; AFRL-IF-RS-TR-1999-216; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The objective of this effort was to determine the potential user base of the three-dimensional (3-D) volumetric memory (VM) technology currently under development at AFRL, Rome Research Site. A secondary objective was to determine the system

characteristics this storage technology must possess to ensure successful transition into current and emerging weapon systems. The technical approach followed included a survey of potential storage technology users. The results summarized in this report support the high potential viability of this technology while helping to establish functional, physical and economic requirements needed to guide its development over the next few years.
DTIC
Optical Memory (Data Storage); Volumetric Analysis

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.

20000018001 Vanderbilt Univ., Nashville, TN USA
Development of a Tele-Micro-Robot for Telemanipulation of a Microscopic Environment ***Final Report, Aug. 1995 - Jun. 1998***
Goldfarb, Michael, Vanderbilt Univ., USA; 1998; 4p; In English
Contract(s)/Grant(s): NAGW-4723; NAG5-3341; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The objective of the proposed work was to design and develop the mechanical equivalent of a stereomicroscope in order to eliminate the mismatch that currently exists between one's ability to observe a microscopic environment and one's ability to manipulate it.
Author
Robots; Teleoperators; Manipulators; Fabrication; Design Analysis

20000019584 Naval Postgraduate School, Monterey, CA USA
Induction to Hidden Markov Models and Their Applications to Classification Problems
Zambartas, Michail; Sep. 1999; 153p; In English
Report No.(s): AD-A370899; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This thesis presents an introduction to Hidden Markov models (HMM) and their applications to classification problems. HMMs have been used extensively to model the temporal structure and variability of speech and other signals in the last decade. We selected to write our own HMM implementation in MATLAB. We tested our software on a limited isolated 4-word recognition. We also applied our implementation to the recognition of mine-like objects buried in shallow sand, using seismo-acoustic data obtained from an on-going project at the Naval Postgraduate School. Initial results indicate that the HMM-based classifier can recognize the type of mine-like object, independent of the object weight with a 97% accuracy. Results also indicate that it can recognize the object type at different distances with a 100% accuracy. However, the experiments were conducted with very few data, and further work needs to be done to confirm these initial findings by using a larger data set. Finally, we benchmarked our results against those obtained using a back-propagation neural network implementation, which were found to be similar, but slower than the HMM-based implementation.
DTIC
Speech Recognition; Markov Processes; Signal Processing; Classifiers; Systems Analysis

20000019620 Trident Systems, Inc., Fairfax, VA USA
Novel Mathematical/Computational Approaches to Surveillance Image Transmission and Exploitation, Phase 1 ***Final Report, 1 Aug. 1998 - 31 Jul. 1999***
Hsu, Charles; Oct. 26, 1999; 37p; In English
Contract(s)/Grant(s): F49620-98-C-0036
Report No.(s): AD-A370962; AFRL-SR-BL-TR-99-0271; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
Current image compression algorithms are founded on three basic principles: transformation, quantization, and entropy coding. The transformation attempts to remove statistical redundancies from the input, thereby reducing the data to a smaller, more manageable set. The process of quantization converts samples into a finite set of levels, typically in a way that minimizes some predefined error measure (e.g. mean-squared, mean absolute difference, etc.). The entropy coder converts the quantized output, which is in the form of a sequence of level values, into a bit string. Assignments are made with variable length codes in an attempt to minimize the overall average bit rate of the system. This study examined and developed image compression codes. Current compression methodologies such as Joint Photographers Expert Group (WEG) and others were evaluated in context of Synthetic

Aperture Radar (SAR) image compression. Specifically, this benchmarking was performed in terms of visual quality and Automatic Target Recognition (ATR) performance quality. This is in direct contrast to mean-square error (MSE) and peak signal to noise ratio (PSNR) measures that are commonly used to assess image coding quality in the compression community. This important first step is done in recognition that the true measure of merit for defense applications is the preservation of target classification information after transmission. It was determined that much of the high frequency content found in SAR images was lost due to these compression techniques. Regenerating this speckle by modeling a stochastic process often reduces PSNR and MSE but increase perceptual quality. Speckle extraction and regeneration techniques were developed, implemented and evaluated on real Joint STARS SAR imagery. Image interpretation experts then analyzed and rated the compressed images.
DTIC
Target Recognition; Radar Data; Data Compression; Stochastic Processes; Radar Imagery; Surveillance; Data Reduction

20000019658 Delaware Univ., Dept. of Chemical Engineering, Newark, DE USA
Neurobiologically Inspired Approaches to Nonlinear Process Control and Modeling ***Final Report, 1 Nov. 1997 - 31 Oct. 1999***
Doyle, Francis J., III; Dec. 31, 1999; 6p; In English
Contract(s)/Grant(s): N00014-98-1-0041; N00014-96-1-0695
Report No.(s): AD-A371756; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

Over the course of this project, our efforts have been focused on four distinct activities: (1) the design of locally intelligent actuators (control valve), (2) the development of a neuromodulatory control model of the heart, (3) development of a decentralized state estimation scheme for large scale problems, and (4) formulation of large scale fault estimation problems using mixed integer programming. These items are highlighted in the body of this document.
DTIC
Control Valves; Control Theory; Computer Aided Design; Actuators

20000020761 Stanford Univ., Dept. of Computer Science, Stanford, CA USA
Combination and Interoperation of Logical Systems Research in Formal Interoperability ***Final Report, 1 Jun. 1994-30 Apr. 1999***
McCarthy, John; Talcott, Carolyn; Apr. 30, 1999; 10p; In English
Contract(s)/Grant(s): N00014-94-1-0857
Report No.(s): AD-A371062; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This project involved investigation of both interpretations of the phrase formal interoperability: (1) formal semantics of the interoperation of components and their combination into complex systems; and (2) the interoperation of formal systems and their combined use to specify the many aspects of complex systems. (1) scientific foundations for sensible, correct and secure interaction between components; (2) formalizing different aspects of complex systems and reasoning across such formalizations; and (3) correct interoperation of formal tools such as theorem provers, declarative languages, and analyzers. Progress in several areas of formal interoperability is reported; reasoning systems, heterogeneous architectures, distributed open systems and the use of reflective techniques.
DTIC
Neural Nets; Systems Analysis; Mathematical Logic; Complex Systems

64
NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20000017979 West Virginia Univ., Morgantown, WV USA
Mathematical Problems Related to a Phase Transition ***Final Report***
Hattori, Harumi; Sep. 15, 1998; 7p; In English
Contract(s)/Grant(s): DAAH04-94-G-0246
Report No.(s): AD-A358285; ARO-33578.13-MA-DPS; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The role of memory term in the viscoelasticity with memory became clearer in the context of the stability of rarefraction waves and the travelling waves. The memory term induces a subtle dissipation. This effect was examined. The effects of capilarity term was investigated. The capillarity effect is important where there is a rapid change of density. One example is a phase transition. We have shown the well-posedness for a fluid dynamic model containing capillary effects. The entropy rate

admissibility criterion was used to show the existence of weak solution and also the various properties of the entropy rate admissibility criterion was studied. Through this study the relation between the entropy rate admissibility criterion and the entropy condition became clearer. The stability of steady state solutions is interesting in the sense that the system contains an elliptic equation for the potential. This equation makes the stability proof more interesting. This is another type of elliptic-hyperbolic (or parabolic) mixed type problem. This type of mixed problem has not been studied. We see the effect of elliptic equation in the time dependent problems.
Derived from text
Phase Transformations; Viscoelasticity; Compressible Flow; Applications of Mathematics

20000019572 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
High Order Finite Difference Methods, Multidimensional Linear Problems and Curvilinear Coordinates ***Final Report***
Nordstrom, Jan, Institute for Computer Applications in Science and Engineering, USA; Carpenter, Mark H., NASA Langley Research Center, USA; December 1999; 38p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209834; NAS 1.26:209834; ICASE-99-54; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Boundary and interface conditions are derived for high order finite difference methods applied to multidimensional linear problems in curvilinear coordinates. The boundary and interface conditions lead to conservative schemes and strict and strong stability provided that certain metric conditions are met.
Author
Finite Difference Theory; Spherical Coordinates; Numerical Stability; Interface Stability

20000019609 Helsinki Univ. of Technology, Inst. of Mathematics, Espoo, Finland
On the Iterative Solution of Nonnormal Problems
Hyvonen, Saara, Helsinki Univ. of Technology, Finland; 1999; ISSN 0784-3143; 178p; In English
Report No.(s): PB2000-100774; RR-A416; ISBN 951-22-4607-4; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy
Iterative methods are widely used to solve systems of linear equations. The behavior of Krylov subspace methods is relatively well understood in the case of normal operators. Here we summarize the results of papers (I, II, III, IV, V, VII), in which tools to gain information on the convergence behavior of iterations for nonnormal operators and tested in practice for a set of examples.
NTIS
Iterative Solution; Linear Equations; Operators (Mathematics)

65
STATISTICS AND PROBABILITY

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

20000017943 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
Statistical Properties of Braid Groups in Locally Free Approximation
Vershik, A. M.; Nechaev, S.; Bikbov, R.; Jun. 1999; 40p; In English
Report No.(s): PB99-159394; IHES/M/99/45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Statistical and probabilistic characteristics of locally free group with growing number of generators are defined and their application to statistics of braid groups is given.
NTIS
Statistical Distributions; Approximation; Statistical Analysis

20000019605 Helsinki Univ. of Technology, Dept. of Engineering and Mathematics, Espoo, Finland
Smoothing of Random Errors in the Analysis of Throwing Events
Ranta, Matti A., Helsinki Univ. of Technology, Finland; vonHertzen, Raimo, Helsinki Univ. of Technology, Finland; Rahikainen, Ahti, Helsinki Univ. of Technology, Finland; 1999; ISSN 1456-6311; 24p; In English
Report No.(s): PB2000-100779; ISBN 951-22-4544-2; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy
A computational method for adjusting the initial values of performances of throwing sport has been developed. In general, the release of the missile occurs between two successive frames. In the present method the equation of the flight-path of the missile and information about body positions in the images just before and after the instant of release have been exploited. Consequently,

the initial values of the flight can be determined by the present method with a significantly better accuracy than by the successive images of the motion analysis camera alone. The accuracy of the estimated initial velocity is improved in particular due to the use of the precise equation of the flight-path in place of the traditional fitting using splines.
NTIS
Smoothing; Random Errors; Throwing

20000021030 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Efficient Simulation via Validation and Application of an External Analytical Model
Irish, Thomas H.; Sep. 14, 1999; 259p; In English
Report No.(s): AD-A369028; AFIT/DS/ENS/99-01; No Copyright; Avail: CASI; A03, Microfiche; A12, Hardcopy

This research makes significant contributions towards improving the efficiency of simulation studies using an external analytical model. The foundation for this research is the analytical control variate (ACV) method. The ACV method can produce significant variance reduction, but the resulting point estimate may exhibit bias. A Monte Carlo sampling method for resolving the bias problem is developed and demonstrated through a queueing network example. The method requires knowledge of the parameters and approximate distributions of the random variables used to produce the ACV. Often, some of these parameters or distributions are not known. Both parametric and non-parametric alternatives to the Monte Carlo method are explored for these cases. Significant variance reduction using an ACV indicates that the outputs of both models are highly correlated. This relationship is exploited and a new methodology is developed for conducting searches of a simulation design space using an analytical model vice a simulation model. The justification for the new surrogate search method is based on validating the analytical model to the simulation model. The effectiveness of the method is demonstrated on two simulation models including the HQ AMC Mobility Analysis Support System (MASS) model.
DTIC
Computerized Simulation; Proving

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20000015389 Norwegian Defence Research Establishment, Kjeller, Norway
Artificial Intelligence Techniques with Potential for Use in Two Person Zero Sum Games
Hagenson, N.; Oct. 19, 1998; 44p; In English
Report No.(s): PB99-172561; FFI-RAPPORT-97/05291; ISBN 32-464-0300-1; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report gives an overview of established theory and recent results in artificial intelligence fields which are relevant to two person zero sum games. The following fields are surveyed, game theory, game applications, search, belief networks and other ways of handling uncertainty, fuzzy logic, fuzzy sets, neural networks, knowledge representation, expert systems, genetic algorithms and hybrid approaches.
NTIS
Systems Analysis; Artificial Intelligence; Game Theory; Zero Sum Games

20000015401 Department of Defense, Office of the Inspector General, Washington, DC USA
Year 2000 Initiatives at the Naval Air Warfare Center: Aircraft and Weapons Divisions, and the Atlantic Undersea Test and Evaluation Center
Gimble, Thomas F.; Brannin, Patricia A.; Spencer, Raymond A.; Bartodzek, Thomas S.; Hoffman, Julius L.; Sep. 30, 1998; 21p; In English
Report No.(s): AD-A371391; IG/DOD-98-218; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overall audit objective was to determine whether the major range and test facility year 2000 initiatives at the Naval Air Warfare Center-Aircraft and Weapons Divisions and the Atlantic Undersea Test and Evaluation Center were effective and whether they complied with the DoD Year 2000 Management Plan.
DTIC
Management Planning; Subdivisions; Warfare

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.

20000014445 Nottingham Univ., UK
Second SPIE Conference on Terahertz Spectroscopy and Applications, Volume 3828
Nov. 23, 1999; 453p; In English; 2nd; Terahertz Spectroscopy and Applications, 16-18 Jun. 1999, Munich, Germany
Contract(s)/Grant(s): F61775-99-WF032
Report No.(s): AD-A371280; EOARD-CSP-99-5032; No Copyright; Avail: CASI; A20, Hardcopy; A04, Microfiche

The Final Proceedings for SPIE Conference on Terahertz Spectroscopy & Applications, 16 June 1999 - 18 June 1999 This Is an interdisciplinary conference. Topics will focus on terahertz science and technology. including: pulsed optical techniques for THz generation, intense terahertz sources, remote sensing of airborne pollutants, quantum optics, quantum coherent electronics, new concepts of fundamental sources Including intersubband, exciton, tunneling and plasma wave phenomena, and new fabrication and Integration technologies for Terahertz components.
DTIC
Research and Development; Spectroscopy; Conferences

20000017957 NASA Marshall Space Flight Center, Huntsville, AL USA
An Experimental Study of the Influence of a Rotating Magnetic Field on Rayleigh-Benard Convection
Volz, Martin P., NASA Marshall Space Flight Center, USA; Mazuruk, K., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

A destabilizing vertical temperature gradient and a rotating magnetic field have been applied to a cylindrical column of liquid gallium. The convective flows which arise as a function of these parameters are identified. For small magnetic field strengths, a region of stationary flow is observed. This region is bounded by critical values of the Rayleigh and Hartmann numbers. As the rotating magnetic field is increased, the critical Rayleigh number can increase by more than a factor of 10. The rotating magnetic field itself induces an instability at a critical value of the Hartmann number independent of the Rayleigh number. The nature of the bifurcations (whether subcritical or supercritical) and the convective flows occurring at the critical Rayleigh numbers are dependent upon the Hartmann number. For small Hartmann numbers, the experimental observations are consistent with the occurrence of a single asymmetric meridional roll which is driven around the cylinder by the rotating magnetic field.
Author
Gallium; Hartmann Number; Magnetic Fields; Rayleigh Number; Rayleigh-Benard Convection; Rotation; Temperature Gradients

20000019651 NASA Marshall Space Flight Center, Huntsville, AL USA
Spectral Analysis of Vibrational Harmonic Motion by use of a Continuous-Wave CO2 Doppler Lidar
Jarzembski, Maurice A., NASA Marshall Space Flight Center, USA; Srivastava, Vandana, Universities Space Research Association, USA; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Vibrational motion of a harmonic oscillator was investigated using a focused continuous wave CO2 Doppler lidar at 9.1 microns wavelength. A continuum of frequencies along with many discrete, equally spaced, resonant frequency modes was observed. The frequency modes are similar in structure to the oscillatory longitudinal modes of a laser cavity and arise because of interference of the natural resonant frequency of the oscillator with specific frequencies within the continuum. The spectra revealed departures from linear motion for vigorous vibrations of the oscillator. Each consecutive resonant frequency mode occurred for a movement of the oscillator much less than the wavelength of incident lidar radiation.
Author
Spectrum Analysis; Harmonic Motion; Harmonic Oscillators

20000021029 Naval Air Warfare Center, Weapons Div., China Lake, CA USA
Three Dimensional Finite-Difference Time-Domain Solution of Maxwell's Equations With Perfectly Matched Absorbing Layers ***Interim Report, Oct. 1998 - Sep. 1999***
Elson, J. M.; Sep. 1999; 25p; In English
Report No.(s): AD-A369016; NAWCWD-TP-8447; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

We formulate and document Maxwell's equations in finite-difference time-domain form and for three-dimensional geometry. We incorporate the successful perfectly matched layer absorbing boundary conditions and the coupled-equation-set is presented in various forms depending on space points being inside or outside the absorbing shell. The material media are nonpermeable and nondispersive. These equations provide a basis from which problems requiring time-domain solutions to Maxwell's equations may be approached.
DTIC
Maxwell Equation; Perfectly Matched Layers; Absorbers (Materials); Finite Difference Time Domain Method

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 Propulsion and Power.

20000017990 NASA Goddard Space Flight Center, Greenbelt, MD USA
Phase Time and Envelope Time in Time-Distance Analysis and Acoustic Imaging
Chou, Dean-Yi, Tsinghua Univ., China; Duvall, Thomas L., NASA Goddard Space Flight Center, USA; Sun, Ming-Tsung, Chang Gung Univ., Taiwan, Province of China; Chang, Hsiang-Kuang, Tsinghua Univ., China; Jimenez, Antonio, Instituto de Astrofisica de Canarias, Spain; Rabello-Soares, Maria Cristina, Instituto de Astrofisica de Canarias, Spain; Ai, Guoxiang, Beijing Observatory, China; Wang, Gwo-Ping, Beijing Observatory, China; Goode Philip, New Jersey Inst. of Tech., USA; Marquette, William, New Jersey Inst. of Tech., USA; Ehgamberdiev, Shuhrat, Ulugh Beg Astronomical Inst., Uzbekistan; Landenkov, Oleg, Ulugh Beg Astronomical Inst., Uzbekistan; [1999]; 10p; In English; Sponsored in part by NSC of ROC
Contract(s)/Grant(s): NAG5-3077; NSC-87-2112-M-007-044; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Time-distance analysis and acoustic imaging are two related techniques to probe the local properties of solar interior. In this study, we discuss the relation of phase time and envelope time between the two techniques. The location of the envelope peak of the cross correlation function in time-distance analysis is identified as the travel time of the wave packet formed by modes with the same w/l. The phase time of the cross correlation function provides information of the phase change accumulated along the wave path, including the phase change at the boundaries of the mode cavity. The acoustic signals constructed with the technique of acoustic imaging contain both phase and intensity information. The phase of constructed signals can be studied by computing the cross correlation function between time series constructed with ingoing and outgoing waves. In this study, we use the data taken with the Taiwan Oscillation Network (TON) instrument and the Michelson Doppler Imager (MDI) instrument. The analysis is carried out for the quiet Sun. We use the relation of envelope time versus distance measured in time-distance analyses to construct the acoustic signals in acoustic imaging analyses. The phase time of the cross correlation function of constructed ingoing and outgoing time series is twice the difference between the phase time and envelope time in time-distance analyses as predicted. The envelope peak of the cross correlation function between constructed ingoing and outgoing time series is located at zero time as predicted for results of one-bounce at 3 mHz for all four data sets and two-bounce at 3 mHz for two TON data sets. But it is different from zero for other cases. The cause of the deviation of the envelope peak from zero is not known.
Author
Time Series Analysis; Acoustic Imaging

20000018005 Old Dominion Univ., Dept. of Mathematics and Statistics, Norfolk, VA USA
The Prediction of Noise Scattered by a Wing/Ducted Fan Configuration ***Final Report, Period ending 30 Sep. 1999***
Tweed, John, Old Dominion Univ., USA; Dunn, Mark H., Old Dominion Univ., USA; December 1999; 34p; In English; Original contains color illustrations
Report No.(s): ODURF-190971; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this proof of concept research, a computational method was developed for predicting the sound field created by the scattering of ducted fan engine noise by a blended wing-body (BWB). It was assumed that all acoustic processes were linear and time harmonic with excitation frequency co. Inflow effects were neglected and no penetration boundary conditions were applied to the engine nacelle and BWB surfaces. A scattering approach was adopted in which the total acoustic field is written as the sum of known incident (from the engine duct) and unknown scattered parts. We further assume that the incident field is independent of the scattered field. Application of the above conditions to the equations of linearized acoustics yields the Helmholtz equation (reduced wave equation) for the scattered pressure with Neumann boundary conditions.
Author
Aerodynamic Configurations; Body-Wing Configurations; Engine Noise; Noise Prediction; Scattering; Sound Fields; Wave Equations; Aircraft Noise; Acoustic Scattering

20000019630 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

Modal Scintillation Index: A Physics-Based Statistic for Acoustic Source Depth Discrimination

Premus, V., Massachusetts Inst. of Tech., USA; Journal of Acoustical Society of America; April 1999; ISSN 0001-4966; Volume 105, No. 4, pp. 2170-2180; In English

Contract(s)/Grant(s): F19628-95-C-0002

Report No.(s): AD-A366516; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

A new discriminant based on the scintillation of normal mode amplitudes is introduced for the problem of passive surface/submerged source classification in a shallow water waveguide. The scintillation of modal energies is often used to characterize and understand acoustic wave propagation in a randomly fluctuating ocean waveguide. This paper proposes a variant of the traditional modal scintillation index to treat the discrimination problem in a typical littoral oceanic waveguide. The approach is based on a modal decomposition of fluctuations in the received pressure field associated with the temporal modulation of the depth of an acoustic source about its mean value. Source depth fluctuations we the result of a platform's response to surface or internal wave motion. The rms mode excitations due to source depth modulation are shown to exhibit a depth dependent signature dud may be exploited to statistically separate surface and submerged source classes. In this work, the modal scintillation index (SI) is defined as the variance in the estimated magnitude of the modal excitation normalized by as expected value over some observation interval. The statistic is self normalizing so knowledge of source level and source range is not required to separate the two source classes. Estimation of the modal excitations statistics requires only knowledge of the water depth and the sound speed profile at the array. Classification performance predictions in terms of receiver operating characteristic (ROC) curves will be presented based on KRAKEN Monte Carlo simulations under conditions of known and unknown source depth and range in spatially white Gaussian noise. An ad hoc decision criterion, which compares the minimum scintillation index across all modes to a threshold, was used to illustrate the phenomenology. Vertical line array and horizontal line array endfire geometries were considered. The modal scintillation approach may provide a robust alternative to matched field processing for the problem of binary source depth classification.

Author

Sound Generators; Computerized Simulation; Acoustic Velocity; Water Depth; Modulation; Scintillation

20000020862 Ecole Centrale de Paris, Lab. EM2C, France

Adaptive Control of Aeroacoustic Instabilities with Application to Propulsion Systems

Mettenleiter, M., Ecole Centrale de Paris, France; Haile, E., Ecole Centrale de Paris, France; Candel, S., Ecole Centrale de Paris, France; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 39-1 - 39-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper describes an experimental investigation of adaptive control algorithms applied to aeroacoustic instabilities. The study is carried out on a cold how experimental rig, designed to reproduce the essential features of acoustically coupled vortex shedding. This mechanism is responsible for thrust, oscillations in large segmented solid rocket motors. It, is also found in a wide variety of combustion instabilities. An adaptive control strategy is presented, with selected experimental results. These results show the feasibility of control. We then analyze the effect of the c controller on the instability mechanism, and propose improvements to the control strategy.

Author

Adaptive Control; Aeroacoustics; Propulsion; Solid Propellant Rocket Engines; Combustion; Controllers

20000020927 Georgia Inst. of Tech., Atlanta, GA USA

Measurement of Lung Vibration from Low Frequency Underwater Sound in an Animal Model and Divers Using NIVAMS *Final Report, Jul. 1997-Oct. 1999*

Martin, James S.; Rogers, Peter H.; Oct. 31, 1999; 152p; In English

Contract(s)/Grant(s): N00014-97-1-0949

Report No.(s): AD-A371266; GIT-E-25-A-54; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report contains a description of an investigation of the physiological effects of underwater low frequency sound. The work described includes the design, fabrication, and testing of a travelling wave tube for the controlled insonification of small animals under representative conditions. It also contains a description of an experiment conducted on divers in a hyperbaric chamber to determine the frequency response of the human lung and the effects of depth on this frequency response.

DTIC

Vibration; Vibration Measurement; Lungs; Underwater Acoustics

20000020990 Department of Transportation, Research and Special Programs Administration, Cambridge, MA USA
Ambient Sound Levels at Four Department of Interior Conservation Units in Support of Homestead Air Base Reuse Supplemental Environmental Impact Statement ***Final Report, Jul. 1998 - Jun. 1999***
Fleming, Gregg G.; Roof, Christopher J.; Read, David R.; Burstein, Joseph; Senzig, David; Jun. 1999; 345p; In English; Prepared in collaboration with CSC, Cambridge, MA., and Terrapin Acoustical Services, Relay, MD.
Report No.(s): AD-A368878; DOT-VNTSC-FAA-99-3; FAA-AEE-99-02; No Copyright; Avail: CASI; A03, Microfiche; A15, Hardcopy

The Federal Aviation Administration (FAA), in cooperation with the United States Air Force (USAF), is developing a Supplemental Environmental Impact Statement (SEIS) in support of the planned commercialization of Homestead Air Base in Southern Florida. As part of this SEIS it is important to analyze potential noise impacts in the areas surrounding the airport. An integral part of this undertaking is the comprehensive definition of the associated sound level environment. The FAA and USAF, with the assistance of the Acoustics Facility at the USA Department of Transportation's John A. Volpe National Transportation Systems Center, conducted ambient sound level measurements during the period August 10 through 20, 1998. In total, over 160 hours of acoustical and meteorological data were measured at 29 sites throughout Biscayne National Park, Everglades National Park, Crocodile Lake National Wildlife Refuge, and the southern portion of Big Cypress National Preserve. This document summarizes this comprehensive noise measurement study. Also included is a description of the enhancements made to the FAA's Integrated Noise Model (INM) in Support of the Homestead SEIS.
DTIC
Conservation; Environmental Surveys; Noise Measurement

20000021038 Naval Undersea Warfare Center, Newport, RI USA
Efficient Discrete Fourier Representation of Pulse Responses ***Final Report***
Wettergren, Thomas A.; Jun. 18, 1999; 28p; In English
Report No.(s): AD-A366799; NUWC-NPT-TR-11132; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The problem of modeling the transient response of a linear system to an incident pulse (finite time series) is examined. In mathematical modeling, this problem is solved through the convolution of a time domain pulse with a model-generated transfer function (spectral Green's function) of the linear system under consideration. This report is concerned with a particular class of linear systems, i.e., those that are separable into a superposition of multiple linear subsystems. Such problems arise often in high-frequency acoustics applications, where ray theory is applied and the linear acoustic system is represented as a superposition of many acoustic rays of energy.
DTIC
Transient Response; Signal Processing; Underwater Acoustics; Fourier Transformation

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.

20000020496 NASA Johnson Space Center, Houston, TX USA
Accelerator Facilities for Radiation Research
Cucinotta, Francis A., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 100-105; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

HSRP Goals in Accelerator Use and Development are: 1.Need for ground-based heavy ion and proton facility to understand space radiation effects discussed most recently by NAS/NRC Report (1996). 2. Strategic Program Goals in facility usage and development: -(1) operation of AGS for approximately 600 beam hours/year; (2) operation of Loma Linda University (LLU) proton facility for approximately 400 beam hours/year; (3) construction of BAF facility; and (4) collaborative research at HIMAC in Japan and with other existing or potential international facilities. 3. MOA with LLU has been established to provide proton beams with energies of 40-250 important for trapped protons and solar proton events. 4. Limited number of beam hours available at Brookhaven National Laboratory's (BNL) Alternating Gradient Synchrotron (AGS).
Author
Research Facilities; Particle Accelerators; Proton Beams; Gradients; Construction; Aerospace Medicine

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OPTICS

Includes light phenomena and the theory of optical devices. For lasers see 36 Lasers and Masers.

20000017948 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Pattern Asymmetries in Phase-Edge Imaging
Fritze, Michael, Massachusetts Inst. of Tech., USA; Cann, Sue, Massachusetts Inst. of Tech., USA; Wyatt, Peter, Massachusetts Inst. of Tech., USA; Mar. 19, 1999; 18p; In English; 7th; Optical Microlithography, 17-19 Mar. 1999, Santa Clara, CA, USA
Contract(s)/Grant(s): F19628-95-C-0002
Report No.(s): AD-A369271; MS-13248; ESC-TR-98-071; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Strong phase-shift methods such as alternating aperture and chromeless edge are resolution-enhancement techniques (RETs) that promise to extend optical lithography to the 100-nm regime and possibly below. An example, of the imaging obtainable using strong phase-shifting is included in a figure. Semi-isolated polysilicon features of 60-nm critical dimension (CD) were fabricated using a 248-nm stepper. In order to help evaluate the practical application of this RET to circuit fabrication, it is important to understand the origin of asymmetries that can occur with such imaging techniques. Two experimentally observed asymmetries will be explored involving linewidth and pitch.
Author
Asymmetry; Imaging Techniques; Lithography

20000019566 NASA Marshall Space Flight Center, Huntsville, AL USA
Astronomical X-Ray Optics
Joy, M. K., NASA Marshall Space Flight Center, USA; [2000]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Over the past two decades, grazing incidence optics have transformed observational x-ray astronomy into a major scientific discipline at the cutting edge of research in astrophysics and cosmology. This review summarizes the fundamental design principles of grazing incidence optics for astronomical applications, describes the capabilities of the current generation of x-ray telescopes, and explores several avenues of future development.
Author
Grazing Incidence; X Ray Astronomy; X Ray Optics; X Ray Telescopes; Grazing Incidence Telescopes

20000019653 NASA Marshall Space Flight Center, Huntsville, AL USA
Development of Constellation-X Optics Technologies at MSFC
Odell, S. L., NASA Marshall Space Flight Center, USA; Jones, W. D., NASA Marshall Space Flight Center, USA; Smith, W. S., NASA Marshall Space Flight Center, USA; Ramsey, B. D., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English; Astronomical Telescopes and Instrumentation, 27-31 Mar. 2000, Munich, Germany; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

One of the major technological challenges for the Constellation X-ray Mission is the development of light-weight, high-resolution, grazing-incidence optics. NASA's Marshall Space Flight Center is developing and evaluating candidate technologies, based upon full-shell replication off precision mandrels. Here we report on recent progress in meeting the weight and imaging-performance requirements, using very thin, high-strength electroformed nickel alloys. In addition, we briefly describe MSFC's optics fabrication, metrology, and x-ray test facilities.
Author
High Resolution; Grazing Incidence; X Ray Optics; X Ray Telescopes

20000020764 Arnold Engineering Development Center, Arnold AFS, TN USA
Space Environmental and Contamination Effects on Cryogenic and Warm Optical Surfaces - A Review
Wood, B. E.; Bartrand, W. T.; Seiber, B. L.; Lesho, J. C.; Uy, O. M.; Jan. 1999; 12p; In English; Prepared in cooperation with Sverdrup Technology, Inc.; Johns Hopkins Univ./Applied Physics Lab, Laurel, MD; The Aerospace Corporation, El Segundo, CA; Utah State University/Space Dynamics Laboratory, Logan, UT.
Report No.(s): AD-A371092; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This review paper focuses on measurement techniques and facilities for the study of the contamination and space environment effects on optical and thermal radiative surfaces. Laboratory measurements are reviewed and illustrate how cryogenic and relatively warm surfaces can he affected by contaminants, vacuum, and UV. The laboratory data are used to illustrate the important parameters that require consideration when trying to determine these types of effects on future satellite missions. Optical

properties of thin contaminant films, BRDF measurements on cryogenic films, quartz crystal microbalance (QCM) measurements, and UV effects on silicone/hydrocarbon films are presented and discussed relative to their applications to satellite systems. The laboratory data are complemented with flight data from the Midcourse Space Experiment (MSX) satellite. Laboratory results were used to interpret MSX spacecraft flight data. The MSX demonstration and validation satellite program was funded by the Ballistic Missile Defense Organization (BMDO). MSX had UV, visible, and infrared instruments including the Spirit 3 cryogenic telescope and had several contamination instruments for measuring pressure, gas species, water and particulate concentrations, and condensable gas species. Some of the data collected from the flight QCMs are presented.
DTIC
Optical Properties; Contamination; Cryogenics; Aerospace Environments; Environment Effects; Ballistic Missiles; Missile Defense; Contaminants

75
PLASMA PHYSICS

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

20000014444 Academy of Sciences (USSR), High Energy Density Research Center, Moscow, USSR
Development of Computational Techniques for Studying Interpenetrating Plasma Flows and Microwave Impulse *Final Report*
Stupitsky, Evgeniy L.; Sep. 30, 1999; 37p; In English
Contract(s)/Grant(s): F61775-98-W-E124
Report No.(s): AD-A371268; EOARD-SPC-98-4079; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking High Energy Density Research Center (HEDRC) as follows: The contractor will simulate the merging plasma ensemble as three fluids one for the ion component of each plasma and one for a single common electron fluid. Issues which must be successfully addressed include conservation of momentum and energy, accommodating widely varying time scales for different processes, and avoidance of numerical artifacts such as numerical diffusion. They will evaluate and determine the most effective algorithms.
DTIC
Plasmas (Physics); Microwaves; Impulses; Magnetohydrodynamic Flow; Plasma Physics

20000017915 Alabama Univ., Huntsville, AL USA
Shuttle-Based Space Plasma Physics Science Accomplishments
Horwitz, James L., Alabama Univ., USA; Spacelab Science Results Study; Aug. 18, 1999; Volume 1, pp. 26-52; In English; See also 20000017914; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

In this report, we attempt to provide a perspective and summary of published science accomplishments in the areas of Shuttle-based studies of Space Plasmas, having at least to some connection with the charged particle environment. We have chosen to employ a mixed itemization/classification/groupings of the science accomplishments, in some cases based on the scientific nature of the effort or the phenomenon, in some cases based on the technique or experimental method, and in one case, the science accomplishments for that particular mission.
Author
Charged Particles; Space Plasmas; Particle Energy

20000017955 NASA Marshall Space Flight Center, Huntsville, AL USA
Innovation in Space Plasma Instrumentation
Vaisberg, Oleg L., NASA Marshall Space Flight Center, USA; [1999]; 1p; In English, 13 Dec. 1999, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Further progress in space plasma physics to a large degree depends on the quality of in-situ plasma diagnostics. The need in faster instruments, better velocity space coverage, adequate mass resolution leads to developing very sophisticated plasma spectrometers and particle detectors. Mass and data rate limitations for spaceborne instruments, strong competition require even more experimental creativity. The trend in current instrumental developments strongly depends on fast position-sensitive detectors, which continue to improve. Better velocity space coverage is often provided by angular electrostatic scanners. The speed of plasma spectrometers may be increased with use of multichannel plasma analyzers. The time-of-flight measurement is currently dominating mass-resolving technique. The need in improving mass-resolution and problems associated with the use of

high voltage require further development. Very high data rate of contemporary plasma spectrometers often significantly exceeds data transmission rate, and leads to use of onboard data processing. However, some data processing techniques, like onboard moment calculation, may compromise the quality of the data.
Author
Airborne/Spaceborne Computers; Onboard Data Processing; Plasma Physics; Plasmas (Physics); Space Plasmas; Spectrometers

20000020918 Arizona Univ., Dept. of Electrical and Computer Engineering, Tucson, AZ USA
Upgrading the Field-Particle Physics and Numerics of PIC Codes for HPM Tube Design ***Final Report, 1 Aug. 1998 - 31 Jul. 1999***
Yaghjian, Arthur D.; Ziolkowski, Richard W.; Jul. 31, 1999; 24p; In English
Contract(s)/Grant(s): F49620-98-C-0044
Report No.(s): AD-A370145; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
The primary objective of this contract was to develop an understanding from first principles of the macroscopic particle force equation arising from the microscopic particle and field interaction dynamics and to incorporate those effects in a self consistent state space (rate equation) particle in cell (PIC) calculation. Effective current and charge density time domain equation models were to be developed from this generalized Lorentz force model. Also to be developed in this project were the numerical modeling techniques that would allow the self consistent coupling of the particle motions and the evolution of the electromagnetic fields in the presence of complex electromagnetic scatterers. The resulting simulators were to be applied to a variety of high power microwave (HPM) source configurations. The specific tasks considered during the contract period included: (1) develop a generalized Lorentz force equation to include self forces on the particles and to develop its equivalent current and charge rate equations directly in the space time domain; (2) develop the PIC tools and techniques for modeling the interaction of intense electromagnetic fields with one on several particles in one, two, and three space dimensions and time; (3) apply the resulting simulators to study the generation of microwaves in a HPM source cavity, particularly by predicting any additional microscopically derived force effects on a large number of charged particles; and (4) apply the resulting simulators to study a many particle plasma system typically found in HPM sources.
DTIC
Charged Particles; Electromagnetic Fields; Microwave Tubes; Particle In Cell Technique

20000020953 Los Alamos National Lab., NM USA
Proceedings of the twelfth target fabrication specialists' meeting
Dec. 31, 1999; 698p; In English; 12th; Target fabrication specialists' meeting
Report No.(s): DE99-002228; LA-UR-99-585; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy
Research in fabrication for inertial confinement fusion (ICF) comprises at least three broad categories: targets for high energy density physics on existing drivers, ignition capsule fabrication, and cryogenic fuel layer formation. The latter two are being pursued primarily for the National Ignition Facility (NIF). Scientists from over 14 laboratories, universities, and businesses contributed over 100 papers on all aspects of ICF target fabrication. The NIF is well along in construction and photos of poured concrete and exposed steel added to the technical excitement. It was clear from the meeting that there has been significant progress toward the fabrication of an ignition target for NIF and that new techniques are resulting in higher quality targets for high energy density research.
NTIS
Inertial Confinement Fusion; Conferences; Laser Targets; Fabrication

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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.

20000015399 North Carolina State Univ., Raleigh, NC USA
Accelerated Program Development of High-Quality, Large-Area GaN and AlGaN Substrates ***Final Report, 1 May 1996-31 Dec 1998***
Schetzina, J. F.; Aug. 12, 1999; 56p; In English
Contract(s)/Grant(s): N00014-96-1-0713; Proj-98PR03283-00
Report No.(s): AD-A371383; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The purpose of this work was to explore growth of thick layers of GaN, AlN, and AlGaN for use as substrates in III-N device epitaxy using sublimation vapor phase epitaxy (SVPE). The SVPE system was a vertical, cold-wall, pancake-style reactor similar in design to a MOCVD reactor. Ammonia was used as a nitrogen source, while the group III precursors were gallium chloride, GaCl3, and aluminum chloride, AlCl3. All growths were performed on sapphire substrates with approx. 1 micrometer GaN buffer layers prepared by MOCVD.
DTIC
Aluminum Compounds; Crystal Growth; Gallium Nitrides

20000018026 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan
Transport Mechanism of Point Defects in Silicon Crystals Estimated by Molecular Dynamics
Kakimoto, Koichi, Kyushu Univ., Japan; Umehara, Takeshi, Kyushu Univ., Japan; Ozoe, Hiroyuki, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1999; ISSN 0914-3793; Volume 13, No. 2, pp. 87-90; In Japanese; No Copyright; Avail: Issuing Activity

Molecular dynamics simulation of vacancy and self-interstitial atoms in silicon crystals was carried out to investigate diffusion mechanism and coefficients of vacancy and self-interstitial atoms. Pressure dependence of diffusion coefficients of the point defects is not significant, although temperature dependence is remarkably large. Large deformation of lattice was observed in an interstitial case, while small lattice distortion was obtained in a vacancy case.
Author
Crystals; Molecular Dynamics; Silicon; Transport Properties; Crystal Defects; Crystallography

20000019612 California State Univ., Dept. of Physics, Northridge, CA USA
First-Principles Studies of the Sigma5 Tilt Grain Boundary in Ni3Al
Lu, Gang, California State Univ., USA; Kioussis, Nicholas, California State Univ., USA; Wu, R., California State Univ., USA; Physical Review B; Jan. 01, 1999; ISSN 0163-1829; Volume 59, No. 2, pp. 891-898; In English; Sponsored in part by Keck Foundation
Contract(s)/Grant(s): DAAG55-97-1-0093
Report No.(s): AD-A369900; ARO-34340.1-PH; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

The atomic and the electronic structures of the sigma5 (210) [001] tilt grain boundary in Ni3Al, with and without a hydrogen impurity, have been calculated using the full potential linearized-augmented plane-wave method. The strain field normal to the boundary plane and the excess grain boundary volume are calculated and compared with the results obtained using the embedded-atom method (EAM). The interlayer strain normal to the grain boundary oscillates with increasing distance from the grain boundary. The bonding charge distributions suggest that bonding in the boundary region is different from that in the bulk. Total-energy calculations show that the hydrogen impurity prefers to occupy interstitial sites on the Ni-rich grain boundary plane. Hydrogen is found to reduce the bonding charge across the boundary plane. The grain boundary energy and the Griffith cohesive energy for both the ”clean” and H-segregated grain boundary are calculated and compared with the available EAM results. The hydrogen impurity is found to increase the grain boundary energy and reduce the Griffith cohesive energy of the boundary, which indicates that hydrogen is an embrittler of the grain boundary.
Author
Atomic Structure; Electronic Structure; Grain Boundaries; Grain Size; Embedded Atom Method

20000020745 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Electrical and Optical Characterization of Intrinsic and Ion-Implantation Induced Defects in 6H- and 4H-SiC
Scott, Michael B.; Nov. 1999; 257p; In English
Report No.(s): AD-A371042; AFIT/DS/ENP/97-09; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

Deep level transient spectroscopy (DLTS), Hall effect, and cathodolummescence (CL) measurements are used to characterize the intrinsic and ion-implantation induced defects in high-temperature (475 and 500 deg C) ion-implanted epitaxial n-type 6H- and 4H-SiC, ion-implanted with Cr, Mg, Ar, N, and P atoms. Comparison of room-temperature and high-temperature ion-implanted 6H-SiC:Mg and :Cr indicate the significance of high-temperature ion implantation on the activation of the ion-implanted atoms and damage-recovery of the crystalline lattice. The effects of high-temperature annealing on both damage-recovery and implanted ion activation are detected and analyzed, from 1200 to 1800 degrees C. Trap parameters 0 both damage-related and species-related defects are determined by curve-fitting of DLTS rate window plots, including the identification of a 615 meV silicon-vacancy-substitutional-nitrogen defect. Double-correlated DLTS measurements indicate a one-dimensional distribution of various defects along the implantation axis and slight surface diffusion of ion-implanted magnesium during high-temperature annealing. Current-voltage-temperature measurements of 6H-SiC:Mg :Cr indicate the effect

of annealing temperature and ion species on the concentration of near midgap defects. Optimum anneal temperatures are determined for activation of ion-implanted nitrogen and phosphorus. CL measurements indicate the formation of deep radiative centers in 500 degrees C ion-implanted 4H-SiC:P and :N. CL measurements also indicate the presence of a 130 meV higher energy level conduction band minimum.
DTIC
Ion Implantation; Electrical Properties; Temperature Effects; Silicon Carbides; Semiconductors (Materials); Epitaxy; Hall Effect

20000020909 National Renewable Energy Lab., Golden, CO USA
Optical Investigation of GaNAs
Keyes, B. M.; Kramer, C.; Friedman, D. J.; Geisz, J. F.; Olson, J. M.; Sep. 28, 1998; 6p; In English; National Center for Photovoltaics Program Review Meeting, 8-11 Sep. 1998, Denver, CO, USA
Report No.(s): DE00-006587; NREL/CP-520-25512; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy
A systematic study of the energy and time-resolved photoluminescence of GaInP/GaN(x)As(1-x) double heterostructures has been performed for 0=x=1.3%. A large temperature-dependent optical-bowing coefficient (about 20-25 eV) is observed and the bandgap variation with temperature is found to depend on the nitrogen content. Finally, the minority-carrier lifetime is not simply related to the nitrogen content. Instead, the recombination rate is proportional to the majority-carrier concentration for x=0.3% and the carbon concentration for x=0.3%.
NTIS
Photoluminescence; Gallium Nitrides; Gallium Arsenides; Heterojunctions; Indium Phosphides; Gallium Phosphides; Temperature Dependence

20000020958 National Renewable Energy Lab., Golden, CO USA
Large-Signal Injection-Level Spectroscopy of Impurities in Silicon
Ahrenkiel, R. K.; Johnston, S. W.; Oct. 16, 1998; 6p; In English; National Center for Photovoltaics Program Review Meeting, 8-11 Sep. 1998, Denver, CO, USA
Report No.(s): DE00-007136; NREL/CP-520-25628; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy
Deep level defects in silicon are identified by measuring the recombination lifetime as a function of the injection level. The basic models for recombination at deep and shallow centers is developed. The defect used for the theoretical model is the well-known interstitial Fe ion in silicon. Data are presented on silicon samples ranging in defect content from intentionally Fe-doped samples to an ultra-pure float-zone grown sample. These data are analyzed in terms of the injection-level spectroscopy model.
NTIS
Crystal Defects; Doped Crystals; Interstitials; Silicon; Impurities; Spectroscopy

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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.

20000014455 National Inst. of Standards and Technology, Gaithersburg, MD USA
Thin Interface Asymptotics for an Energy/Entropy Approach to Phase-Field Models with Unequal Conductivities
McFadden, G. B., National Inst. of Standards and Technology, USA; Wheeler, A. A., Southampton Univ., UK; Anderson, D. M., George Mason Univ., USA; September 1999; 30p; In English
Report No.(s): PB2000-100781; NISTIR-6377; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
Karma and Rapped recently developed a new sharp interface asymptotic analysis of the phase-field equations that is especially appropriate for modeling dendritic growth at low undercoolings. Their approach relieves a stringent restriction on the interface thickness that applies in the conventional asymptotic analysis, and has the added advantage that interfacial kinetic effects can also be eliminated. However, their analysis focussed on the case of equal thermal conductivities in the solid and liquid phases; when applied to a standard phase-field model with unequal conductivities, anomalous terms arise in the limiting forms of the boundary conditions for the interfacial temperature that are not present in conventional sharp-interface solidification models, as discussed further by Almgren. In this paper we apply their asymptotic methodology to a generalized phase-field model which is derived using a thermodynamically consistent approach that is based on independent entropy and internal energy gradient

functionals that include double wells in both the entropy and internal energy densities. The additional degrees of freedom associated with the generalized phased-field equations can be chosen to eliminate the anomalous terms that arise for unequal conductivities.
Author (NTIS)
Asymptotic Series; Asymptotic Properties; Asymptotic Methods; Crystal Growth; Dendritic Crystals

20000014458 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Classical Solutions in the Born-Infeld Theory
Yang, Yisong, Polytechnic Univ., USA; August 1998; 30p; In English
Contract(s)/Grant(s): NSF DMS-95-96041
Report No.(s): PB2000-100770; IHES/M/99/66; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
Locally concentrated solutions in the Born-Infeld theory are presented. In particular, existence and uniqueness theorems are established for multicentered magnetic string solutions induced from a Higgs field over a closed Riemann surface or an Euclidean plane. On any given compact surface, the Born-Infeld parameter may be adjusted under a necessary and sufficient condition to allow the existence of an arbitrarily large number of strings.
Author (NTIS)
Born-Infeld Theory; Riemann Manifold; Euclidean Geometry

20000015364 California Univ., Dept. of Materials, Santa Barbara, CA USA
Resonant Tunneling Self-Assembled Quantum Dots for Memory Elements ***Final Report, 1 Jun. 1997 - 31 Oct. 1999***
Oct. 31, 1999; 15p; In English
Contract(s)/Grant(s): DAAG55-97-1-0301
Report No.(s): AD-A371376; ARO-35917.4-PH; No Copyright; Avail: Defense Technical Information Center (DTIC), Hardcopy
Two main research topics were studied during this period: (1) Research on buried strain induced quantum dots (SIQDs) generated by self assembling quantum dot (QDs) layers. We investigated here a new type of quantum dots which are generated by the lateral band gap modulation of a quantum well GaAs/AlGaAs induced by a buried layer of self assembled quantum dots. Such SIQDs allow to move the OD confinement regime into the red region of the spectrum. The confinement energies for these SIQDs are function of the distance between the QDs layer and the QW and on the thickness of the QW. They also allow for a greater flexibility for integrating quantum dot devices in device structures. To this end, we have developed an exciton storage device based on quantum dot structures. The device uses pairs of SIQDs and QDs to store the exciton dissociated as an electron hole pair under an internal electric field. The stored e-h pair is restored as an exciton by applying a bias to the device. This method allows for exciton lifetimes of several seconds i.e., more than a billion times the lifetimes of excitons in normal QDs.
DTIC
Quantum Dots; Resonant Tunneling; Computer Storage Devices

20000019610 Iowa Univ., Lab. for Photonics and Quantum Electronics, Iowa City, IA USA
Ultrafast Time-Resolved Quantum Beats in the Polarization State of Coherent Emissions from Quantum Wells
Smirl, Arthur L., Iowa Univ., USA; Chen, X., Iowa Univ., USA; Buccafusca, O., Iowa Univ., USA; Optics Letters; Jul. 15, 1998; ISSN 0146-9592; Volume 23, No. 14, pp. 1120-1122; In English
Contract(s)/Grant(s): DAAG55-98-1-0436
Report No.(s): AD-A369835; ARO-38888.4-EL; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy
Dual-channel spectral interferometry is used to measure the ellipticity, the orientation of the polarization ellipse, and the sense of rotation of the four-wave-mixing signal from a GaAs-AlGaAs multiple quantum well. Each parameter is observed to oscillate dramatically at the heavy-hole-light-hole quantum beat frequency. During each beat period (in the strong quantum beat regime), the ellipticity oscillates twice between linear end almost-circular polarization, the orientation of the polarization ellipse rotates through a complete 180', and the sense of rotation changes from left- to right-circular polarization.
Author
Spectral Signatures; Interferometry; Four-Wave Mixing

20000020871 Alfa Romeo S.p.A., Research and Development Dept., Naples, Italy
Numerical Predictions and Experimental Measurements of Radiative Heat Transfer in Gas Turbine Combustors
DiMartino, P., Alfa Romeo S.p.A., Italy; Cinque, G., Alfa Romeo S.p.A., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 49-1 - 49-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The present paper is concerned with the calculation of the flowfield heat transfer and turbulent combustion processes inside a single annular reverse-flow gas turbine combustor for aircraft engines. Numerical analysis has been carried out by using a CFD home computer code based on finite-volume method and body-conforming non-orthogonal structured grids. Emphasis has been put on the evaluation of wall temperatures distribution, which was assumed in previous works. A comparison with experimental measurements obtained by means of thermal paints has also been performed. A method to evaluate wall temperatures and radiative heat fluxes is described. No attempt has been made to account for the presence of soot First results obtained seem encouraging in that the trend of calculations is in good agreement with experiments. While an amount of work remains to be done in improving physical models, this study shows that CFD can be used as a tool in studying the main features of a gas turbine combustor and in correlation important design parameters.
Author
Radiative Heat Transfer; Gas Turbine Engines; Flow Distribution; Finite Volume Method; Turbulent Combustion; Combustion Chambers; Wall Temperature

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ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20000014452 National Science and Technology Council, Washington, DC USA
Nanostructure Science and Technology. A Worldwide Study *Final Report*
Siegel, R. W., Editor, World Technology Evaluation Center, USA; Hu, E., Editor, World Technology Evaluation Center, USA; Cox, D. M., World Technology Evaluation Center, USA; Goronkin, H., World Technology Evaluation Center, USA; Jelinski, L., World Technology Evaluation Center, USA; Dec. 1998; 368p; In English
Report No.(s): PB2000-101642; No Copyright; Avail: CASI; A03, Microfiche; A16, Hardcopy
To ensure that the Federal government is evaluating ways to make strategic research and development (R&D) investments in this emerging field of nanoscale, the National Science and Technology Council's Interagency Working Group on Nanoscale Science and Technology initiated a study to provide a basis for formulating national R&D priorities and devising a strategy for state, local, and Federal government support. The working group's report, reviews the status of R&D in nanoparticles, nanostructured materials, and nanodevices, including innovative approaches to synthesis and characterization. The report highlights applications in dispersions, high-surface area materials, electronic and magnetic devices, nanostructured materials, and biological systems. It includes a comparative review of research programs around the world - the United States, Japan, Western Europe, and other countries - to help provide a global picture of the field.
NTIS
Research and Development; Nanostructure (Characteristics); Technologies; Research Management

20000015413 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Testimony Before the Subcommittee on Veterans Affairs, Housing and Urban Development and Independent Agencies, Committee on Appropriations, US Senate. Chemical Safety Board: Status of Implementation Efforts
Apr. 29, 1999; 26p; In English
Report No.(s): PB2000-101318; GAO/T-RCED-99-167; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We appreciate this opportunity to provide a statement for the record for use in the Subcommittee's hearing on the fiscal year 2000 budget request for the Chemical Safety and Hazard Investigation Board (the Board). The Board recommends steps to enhance industrial safety based on its investigations of accidental release of toxic and hazardous chemicals and its other activities. We reviewed the status of the Board's efforts to carry out its mission. Specifically, we are providing information on the status of the Board's (1) investigations and recommendations, (2) pay structure and use of staff, and (3) contracting activities. We are also providing information on their concerns about the Board's actions.
NTIS
Congressional Reports; Safety Management; Urban Development; Management Planning; Contract Management

20000015414 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Testimony Before the Subcommittee on VA, HUD and Independent Agencies, Committee on Appropriation, US Senate. Hazardous Waste: Observations on EPA's Cleanup Program amd Budget Management Practices
Apr. 29, 1999; 14p; In English
Report No.(s): PB2000-101319; GAO/T-RCED-99-168; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

You asked us to provide information on three management issues confronting these cleanup programs: (1) the amount of contracts that EPA has awarded to private companies that conduct Superfund cleanup activities for the agency, (2) the extent to which EPA is using its 'Contracts 2000' initiative as a vehicle to improve the agency's Superfund contract management practices, and (3) our perspective on the potential effects of transferring $25 million from the Superfund program's budget to the Corrective Action program's budget as a means of increasing the number of clean ups under RCRA. The authors are issuing a report discussing the progress that EPA and other federal agencies have made in resolving Superfund program management issues.
NTIS
Congressional Reports; Environmental Cleanup; Project Management; Contract Management; Management Planning; Pollution Control; Hazardous Wastes

20000020778 National Inst. of Standards and Technology, Office of Manufacturing Programs, Gaithersburg, MD USA
National Advanced Manufacturing Testbed: A Distributed Testbed Enabling Collaborative Research between Scientists and Engineers at Remote Locations
Stieren, D. C.; Densock, R. J.; Luce, M. E.; Aug. 1999; 34p; In English
Report No.(s): PB99-166803; NISTIR-6383; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The National Advanced Manufacturing Testbed (NAMT) is a distributed testbed enabling collaborative research between scientists and engineers at the National Institute of Standards and Technology (NIST), remote industry locations, and government and university laboratories. Since 1996 the NAMT has been the primary platform for enabling the operation of the Information-Based Manufacturing Program of the NIST Manufacturing Engineering Laboratory (MEL). The NAMT supports the information technology (IT) needs of a collection of advanced research and development (R&D) projects focusing on technology, measurement, and standards issues that are important to the industrial sectors served by NIST. Projects supported by the NAMT serve industries that are customers of the NIST MEL and the other NIST Measurements and Standards Laboratories, as well as the NIST Manufacturing Extension Partnership (www.mep.nist.gov) and Advanced Technology Program (www.atp.nist.gov). The purpose of this report is to document the technological characteristics and functionality of the physical testbed components of the NAMT. The report documents the NAMT design rationale, including reasons why certain technologies and systems were selected to be part of the NAMT versus others.
NTIS
Manufacturing; Information Systems; Test Stands

20000020896 Commerce Dept., Office of Technology Policy, Washington, DC USA
Globalizing Industrial Research and Development
Dalton, D. H.; Serapio, M. G.; Yoshida, P. G.; Sep. 1999; 94p; In English
Report No.(s): PB2000-101859; No Copyright; Avail: National Technical Information Service (NTIS)

Research and development (R&D) spending in the USA by foreign-owned companies is now more than $17 billion, substantially higher than in 1990. This report, an expanded and updated version of the authors' earlier study, sheds important light on the magnitude, nature, and scope of this investment. It also explores the major factors influencing the location decisions of foreign R&D facilities in the USA. This information is important in increasing our understanding of the dynamics of R&D as well as the flow of high-value-added jobs. In a complementary trend to increased foreign R&D investment in the USA, US companies have substantially increased their R&D spending abroad, more than tripling it between 1986 and 1997. The overall globalization of the R&D enterprise is illustrated clearly by the actions of both US and foreign firms.
NTIS
Research and Development; Industries

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DOCUMENTATION AND INFORMATION SCIENCE

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

20000015358 Naval Postgraduate School, Monterey, CA USA
Summary of Research 1998, Department of Physics, *1 Jan. - 31 Dec. 1998*
Maier, William B.; Aug. 1999; 55p; In English
Report No.(s): AD-A371767; NPS-09-99-014; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report contains summaries of research projects in the Department of Physics. A list of recent publications is also included which consists of conference presentations and publications, books, contributions to books, published journal papers, technical reports, and thesis abstracts.
DTIC
Research Management; Abstracts

20000015385 Department of Education, Washington, DC USA
Access America for Students: Strategic Plan
Jul. 30, 1999; 102p; In English
Report No.(s): PB2000-100904; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
In 1997, the National Partnership for Reinventing (NPR) Government outlined a plan, entitled Access America, to provide Americans with better access to Federal services and benefits. Specifically, the plan called for Federal agencies to work together to develop improvements in government services to citizens, business, and other Federal and state government agencies through the reengineering of Federal information systems and the implementation of electronic service delivery mechanisms, particularly Internet-based electronic access and service delivery. While advances in electronic access have been made, many government services are still paper-based and require citizens to make applications in person and/or wait days for the information or services they need to be provided. Through the reengineering of government systems, citizens will one day have access to government services and information 24 hours per day, 7 days per week.
NTIS
Information Systems; Access Control

20000017941 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
The Electronic Documentation Distribution System (EDDS) (slides)
Reichl, Doug; Jun. 14, 1999; 11p; In English
Report No.(s): AD-A368655; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report contains briefing slides concerning the Electronic Documentation Distribution System (EDDS).
DTIC
Security; Data Processing; Data Systems

20000019633 Department of Defense, Office of the Inspector General, Washington, DC USA
Second User Acceptance Test of the Electronic Document Management System at the Defense Finance and Accounting Service Operating Location Omaha, Nebraska
19971024; 22p; In English
Contract(s)/Grant(s): Proj. 6FG-5019.01
Report No.(s): AD-A368856; DOD-AR-98-013; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
This report follows up on the design and development deficiencies identified in our review of the Electronic Document Management system. The initial evaluation was performed in response to a September 19, 1995, request from the Defense Finance and Accounting Service (DFAS) for assistance in reviewing the design and development of the Electronic Document Management vendor payment system. DFAS requested this review to ensure that management and system control requirements were met before system acceptance. The first user acceptance training and test was conducted from April 1 through May 28, 1996. Because of design and development deficiencies identified during the first user acceptance test at the DFAS Omaha Operating Location, testing was suspended on May 28, 1996, so that the contractor could develop and test solutions to the identified deficiencies. We reported the results of the first user acceptance test in IG, DoD, Report No. 97-050, ”Evaluation of Controls Over Workflow Applications Selected for Electronic Document Management,” December 17, 1996. On June 20, 1996, the contractor provided ”Solutions A - T for the DFAS Electronic Document Management Partnership,” which described the solutions and schedule for completion of the deficiencies reported during the first test. The second user acceptance test was from November 19 through December 20, 1996. We announced this followup evaluation of that test on November 18, 1996.
Author
Management Systems; Documents; Acceptability; Electronic Publishing; User Requirements

20000019634 Department of Defense, Office of the Inspector General, Washington, DC USA
Updating the Foreign Disclosure and Technical Information System
Jun. 17, 1998; 38p; In English
Contract(s)/Grant(s): Proj. 7Lg-0040
Report No.(s): AD-A368293; DOD-AR-98-157; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The Secretaries of Defense and State have designated the National Military Information Disclosure Policy Committee as the central interagency authority within the Executive Branch of the US. Government responsible for formulating, promulgating, administering, and monitoring the National Disclosure Policy. The Security Policy Automation Network provides organizations the ability to communicate and coordinate with DoD organizations on foreign disclosure, export control, and international arms control and cooperation subjects. The Foreign Disclosure and Technical Information System (FORDTIS), which resides on the Security Policy Automation Network, assists; the US. Government in meeting its national security objectives by providing a historical database. DoD Directive 5230.11, ”Disclosure of Classified Military Information to Foreign Governments and International Organizations,” and DoD Instruction 5230. 18, ”The DoD Foreign Disclosure and Technical Information System,” require DoD personnel to record in FORDTIS releases of and denials of classified military information.
Author
Information Systems; Governments; Defense Program; Foreign Policy; International Cooperation

20000020743 Space and Naval Warfare Systems Command, San Diego, CA USA
An Expanded Review of Information-System Terminology
Ceruti, Marion G.; Sep. 1999; 20p; In English
Report No.(s): AD-A371047; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Terminology pertaining to database systems is reviewed particularly with respect to relational database systems; heterogeneous, distributed database systems; and information management methods. The literature of a variety of database researchers and data administrators is included in this review. A comparison between the different ways in which some of the terminology is used in the industry is presented. In some cases, different definitions of the same term can be consistent when these definitions pertain to different aspects of the entity that the term represents. In other cases, popular misconceptions about word meanings are explained. Resolutions to conflicts in meaning and usage are suggested. Both the similarity and the diversity of ideas concerning the most basic, as well as the more complex database concepts are covered. For example, the discussions range from an examination of the word, data, in the general section, to the classification of synonyms in the section on semantic heterogeneity. This expanded review contains further comparison between types of data associations and between information storage and retrieval methods. It includes a comparison between knowledge bases and databases.
DTIC
Information Systems; Information Retrieval; Relational Data Bases; Information Management

20000020777 SRI International Corp., Computer Science Lab., Menlo Park, CA USA
Practical Architectures for Survivable Systems and Networks, Phase 1 ***Final Report***
Neumann, Peter G.; Jan. 28, 1999; 189p; In English
Contract(s)/Grant(s): DAKF11-97-C-0020
Report No.(s): AD-A368944; Copyright; Avail: Defense Technical Information Center (DTIC)

This report summarizes the analysis of survivability-related requirements and their interdependence. It also identifies inadequacies in existing commercial systems and the absence of components that hinder the attainment of survivability. It recommends specific architectural structures and other approaches that can help overcome those inadequacies.
DTIC
Systems Engineering; Management Information Systems; Architecture (Computers)

20000020933 New Orleans Univ., Office of Conference Services, LA USA
Proceedings: 17th Annual Gulf of Mexico Information Transfer Meeting . ***Final Report***
McKay, M.; Nides, J.; Sep. 1999; 752p; In English; 17th; Gulf of Mexico Information Transfer, 16 Dec. 1997, Unknown
Report No.(s): PB2000-101761; No Copyright; Avail: National Technical Information Service (NTIS)

;Table of Contents: Deepwater Operations, Part I; Northeastern Gulf of Mexico Environmental Studies, Part I; Geographic Information Systems (GIS) Applications; Atmospheric Sciences; Deepwater Operations, Part II; Northeastern Gulf of Mexico Environmental Studies, Part II; Social and Economic Studies; The MMS Sea Floor Monitoring Program; De Soto Canyon; U.S.-Mexico Natural Resources (with emphasis on Laguna Madre), Part I; Platform Ecology; Environmental and Socioeconomic Information in Deep Waters of the Gulf of Mexico; U.S.-Mexico Natural Resources (with emphasis on Laguna Madre), Part II;

History and Status of the Manteo Project; U.S.-Mexico Offshore Energy Issues; Gulf of Mexico Coastal and Marine Environmental Monitoring, Part I; Coastal Marine Institute, Fate and Effects Study: A Mini-Symposium; Gulf of Mexico Coastal and Marine Environmental Monitoring, Part II; Index to Authors; and Attendees.
NTIS
Conferences; Gulf of Mexico; Environmental Monitoring; Information Transfer; Atmospheric Chemistry; Atmospheric Physics

20000021073 Space and Naval Warfare Systems Command, San Diego, CA USA
Integration of Complex Information
Lange, D. S.; May 1999; 11p; In English
Report No.(s): AD-A371526; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

An intelligence support system has been developed using an open hypermedia architecture. This approach provides a means to integrate information from distributed disparate sources into a knowledge base. Access by external applications is supported through a public interface. Filtering and change detection functions have also been implemented. The approach has shown promise in multiple domains indicating that it may be widely applicable. The integration of systems on a network was accomplished early in this decade. The result has been the creation of information stovepipes all capable of being executed from a common platform. It is left to the system's user to make a mental picture of the current situation by comparing the results displayed from several applications. Using open hypermedia technology, information from a variety of distributed applications and databases can be associated without modifying the original data. In this way, information integration is achieved, bringing diverse information elements together to form a semantic network available to humans and autonomous applications. Using this approach, analysts can model situations more robustly than previously accomplished with relational databases. Consumers of intelligence products are able to use a filtered perspective of the model through hypermedia functions and launch autonomous agents to traverse the semantic network finding particular insights. Supported by an open architecture and public interfaces, the model is available to external applications including geographic, temporal, relational, and browsing displays. Further, hypermedia research provides a variety of user interaction models that can be implemented as external applications.
DTIC
Systems Analysis; Support Systems; Knowledge Based Systems

20000021079 K Systems Corp., Brownsville, MD USA
Computer-Integrated Knowledge System (CIKS) Network: Report of Workshop (2nd)
Kaetzel, L. J., K Systems Corp., USA; Dec. 1999; 110p; In English
Report No.(s): PB2000-102385; NISTIR-6401; No Copyright; Avail: Issuing Activity

The 2nd workshop on a National Partnership on Computer-Integrated Knowledge Systems (CIKS) Network for High-Performance Construction Materials and Systems (NPCMS) was held in Gaithersburg, MD on September 24th and 25th, 1997. The workshop mission was to provide a forum for developing and participating in an industry-wide effort to address the information needs of private and public organizations within the construction industry. The workshop objectives were to: identify and prioritize current and future information needs of the construction industry as they relate to construction materials and systems; critique the proposed framework for developing and implementing CIKS; and identify and assess opportunities for private and public partnersips for developing CIKS.
NTIS
Knowledge Based Systems; Construction Industry; Information Systems; Construction Materials; Computers

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LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes: aviation law; space law and policy; international law; international cooperation; and patent policy

20000014456 International Trade Commission, Office of Economics, Washington, DC USA
International Economic Review
Nov.-Dec. 1998; 27p; In English
Report No.(s): PB2000-101040; USITC-Pub-3151; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The International Economic Review (IER) is a regular staff publication of the Office of Economics, U.S. International Trade Commission. The opinions and conclusions it contains are those of the authors and do not necessarily reflect the views of the Commission or of any individual Commissioner. The IER is produced as part of the significant developments in international

economics and trade and to maintain the Commission's readiness to carry out its responsibility to provide technical information and advice on international trade matters to policy-makers in the Congress and the Executive branch.
Author (NTIS)
Economics; International Trade

20000020924 National Defence Research Establishment, Div. of Defence Analysis, Stockholm, Sweden
FIND Projektet (Defence-Industrial Policy of the USA) ***Amerikansk Foersvarsindustripolitik***
Jarlsvik, H.; Dec. 1998; 50p; In Swedish
Report No.(s): PB2000-101442; FOA-R-98-00779-170-SE; No Copyright; Avail: Issuing Activity
The defense industry of the USA has changed dramatically during the 1990s. The industry has gone through a restructuring phase, companies invest in dual-use technology and the transatlantic cooperation grows. The American political actors have tried to influence this development with their defense-industrial policy and the aim of this base data report is to describe the defense industrial policy of the 1990s.
NTIS
Defense Industry; Policies

85
TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see 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.

20000014435 Michigan Univ., Office for the Study of Automotive Transportation, Ann Arbor, MI USA
Emerging Needs for Nontraditional Transit ***Final Report, 1 Oct. 1996 - 31 Aug. 1999***
Richardson, Barbara C., Michigan Univ., USA; Huang, Hui-Chun, Michigan Univ., USA; Ebarvia, Brian N., Michigan Univ., USA; Aug. 31, 1999; 118p; In English
Contract(s)/Grant(s): DTRS95-D-0005
Report No.(s): PB2000-101072; UMTRI-99-27; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy
With expected demographic and economic changes, there is an expectation of need for innovative transportation for different segments of society, particularly those who will be unable to drive personal vehicles for reasons of health or cost. In this study, two groups, the elderly and those of low income were studied in regard to their current and future transportation needs and modes. A review of the literature was supplemented by interviews with service providers and focus groups. The findings of the study are organized by which innovative transportation solutions (for both personal and public modes) are likely to contribute positively in meeting the desired transportation attributes indicated by the two populations. It was found that services that make personal vehicles more affordable would contribute most to providing the desired transportation attributes to those who are physically able to drive. For those who use public transportation, services that make it more convenient, e.g., geographically and temporally, and those that improve security are likely to make the greatest contribution toward providing the desired transportation attributes.
Author (NTIS)
Transportation; Demography; Populations

20000019617 National Defense Industrial Association, Arlington, VA USA
National Defense Industrial Association: Strength Through Industry & Technology. 2nd Annual DoD Maintenance Symposium & Exhibition
Oct. 21, 1998; 154p; In English
Report No.(s): AD-A369593; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This presentation contains information on the logistics information superiority experiment.
CASI
Logistics; Conferences; Military Operations

20000019676 Department of Transportation, Washington, DC USA
Department of Transportation Performance Plan, FY 2000
1999; 98p; In English; Original contains color illustrations
Report No.(s): PB2000-101530; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The Department of Transportation Strategic Plan provides a comprehensive vision for advancing the nation's complex and vital transportation system into the 21st Century. The plan sets forth a strategy for DOT for Fiscal Years (FYs) 1997 through 2002, setting broad goals, targeting outcomes and identifying key challenges. The DOT Strategic Plan sets forth the overall direction, vision, and mission of the Department.
NTIS
Transportation; Complex Systems; Performance Prediction; Evaluation

20000020923 Department of Transportation, Office of the Inspector General, Washington, DC USA
Office of Inspector General US Department of Transporation Strategic Plan, 1999-2004
Oct. 1, 1998; 22p; In English
Report No.(s): PB2000-101526; No Copyright; Avail: National Technical Information Service (NTIS)
The Office of Inspector General (OIG), department of Transportation (DOT), Strategic Plan details our future plans in support of the Secretary's Strategic Plan. The following sections include: (1) OIG's mission statement and statutory responsibilities; (2) OIG's (and DOT's) strategic goals, corporate management strategies, and issue areas we plan on addressing in the next 5 years; (3) internal and external factors which will affect the OIG's achievement of its strategic goals (e.g., organization, staffing, resources, secretarial/congressional priorities, etc.); and (4) discussion of how we will measure and evaluate the OIG's performance in the context of our annual performance plans and reports.
NTIS
Inspection; Priorities; Transportation; Organizations

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SPACE SCIENCES (GENERAL)

20000017914 Alabama Univ., Huntsville, AL USA
Spacelab Science Results Study, Volume 1, External Observations *Final Report*
Naumann, Robert J., Compiler, Alabama Univ., USA; Aug. 18, 1999; 124p; In English; See also 20000017915 through 20000017918
Contract(s)/Grant(s): NAS8-97095; NASA Order H-30194-D; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Some of the 36 Spacelab missions were more or less dedicated to specific scientific disciplines, while other carried a eclectic mixture of experiments ranging from astrophysics to life sciences. However, the experiments can be logically classified into two general categories; those that make use of the Shuttle as an observing platform for external phenomena (including those which use the Shuttle in an interactive mode) and those which use the Shuttle as a microgravity laboratory. This first volume of this Spacelab Science Results study will be devoted to experiments of the first category. The disciplines included are Astrophysics, Solar Physics, Space Plasma Physics, Atmospheric Sciences, and Earth Sciences. Because of the large number of microgravity investigations, Volume 2 will be devoted to Microgravity Sciences, which includes Fluid Physics, Combustion Science, Materials Science, and Biotechnology, and Volume 3 will be devoted to Space Life Sciences, which studies the response and adaptability of living organisms to the microgravity environment.
Author
Adaptation; Aerodynamics; Atmospheric Chemistry; Atmospheric Physics; Biotechnology; Life Sciences; Microgravity; Space Flight

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ASTRONOMY

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20000019567 NASA Marshall Space Flight Center, Huntsville, AL USA
Imaging the Sunyaev-Zeldovich Effect in the High Redshift Galaxy Cluster MS1137+66
Joy, M. K.; Patel, S. K.; Carlstrom, J. E.; Grego, L.; Holder, G. P.; Holzapfel, W. L.; Hughes, J. P.; Reese, E. D.; [2000]; 1p; In English, Jan. 2000, Atlanta, GA, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

We present interferometric measurements of the Sunyaev-Zelldovich Effect (SZE) in MS1137+66, a distant galaxy cluster at a redshift of 0.78. The data were obtained in 1997 and 1998 at the Berkeley-Illinois-Maryland millimeter array using sensitive 28.5 GHz receivers optimized for imaging of the SZE, with a total on-source integration time of 87.8 hours. We discuss constraints derived from spherical ”beta” model fits to the SZE data, place an upper limit on the strength of any possible radio point sources in the field, and compare the results with the x-ray data published by Donahue et al. in 1999.
Author
Background Radiation; Galactic Clusters; Extraterrestrial Radiation; Galactic Radiation

20000019579 NASA Goddard Space Flight Center, Greenbelt, MD USA
BeppoSAX Observation of NGC 7582: Constraints on the X-Ray Absorber
Turner, T. J., NASA Goddard Space Flight Center, USA; Fiore, F., SAX/SDC, Italy; Perola, G. C., Rome III Univ., Italy; Matt, G., Rome III Univ., Italy; George, I. M., NASA Goddard Space Flight Center, USA; Piro, L., Consiglio Nazionale delle Ricerche, Italy; Bassani, L., Consiglio Nazionale delle Ricerche, Italy; [1999]; 26p; In English
Contract(s)/Grant(s): NGC-7582; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a BeppoSAX observation of NGC 7582 made during 1998 November and an optical spectrum taken in 1998 October. The new X-ray data reveal a previously unknown hard X-ray component in NGC 7582, peaking close to 20 keV. Rapid variability is observed with correlated changes in the 5-10 and 13-60 keV bands indicating that a single continuum component, produced by the active nucleus, provides the, dominant flux across both bands. Comparison between RXTE and BeppoSAX data reveals changes in the 2 - 10 keV flux on timescales of months. Changes in the nuclear X-ray flux appear unrelated to the gradual decline in optical flux noted since the high-state in 1998 July. The 0.5 - 2 keV flux of NGC 7582 is not significantly variable within the BeppoSAX observation, but has brightened by a factor of approximately 2 since the ASCA observation of 1994. While there is some concern about contamination from spatially-unresolved sources, the long-term variability in soft X-ray flux seems most likely associated with the nucleus or an event within the host galaxy of NGC 7582. The 2 - 100 keV spectrum is well fit by a powerlaw of photon index Gamma = 1.95(sup +0.09, sub -0.18) steeper by Delta.Gamma approximately equal 0.40 than the index during the 1994 ASCA observation. The X-ray continuum is attenuated by a thick absorber of N(H) approximately 1.6 x10(exp 24)/sq cm covering approximately 60(sup +10%, sub -14%) of the nucleus plus a screen with N(sub H) approximately 1.4 x 10(exp 23)/ sq cm covering the entire nucleus. Comparison of the BeppoSAX and ASCA spectra shows an increase in the full screen by Delta.N(sub H) approximately equal 7 x 10(exp 22)/sq cm since 1994, confirming the absorption variability found by Xue et al. The increase in soft X-ray flux between 1994 and 1998 is consistent with the appearance of holes in the full screen allowing approximately is less than 1% of the nuclear flux to escape, and producing some clear lines-of-sight to the broad-line-region. The data are also consistent with the scenario suggested by Aretxaga et al, of the radiative onset of a type IIn supernova causing the observed optical change in NGC 7582.
Author
Galactic Clusters; Active Galactic Nuclei; Active Galaxies; Supernovae; Seyfert Galaxies

20000020998 Gemini 8m Telescopes Project, Tucson, AZ USA
Gemini Observatory Newsletter, Issue 19
Michaud, Peter, Editor, Gemini 8m Telescopes Project, USA; December 1999; 32p; In English; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy

The Gemini project is a multi-national effort to build twin 8.1 meter astronomical telescopes utilizing new technology to produce some of the sharpest views of the universe ever. One telescope will be located atop Hawaii’s Mauna Kea and the other atop Chile’s Cerro Pachon - together they will provide complete unobstructed coverage of both the Northern and Southern skies. This newsletter discusses the progress of the project, such as the dedication ceremony for Gemini North, the expansion of the adaptive optics program, the sharing of the infrared spectrometer at the Keck observatory, and the improvement of the internet support for the Gemini South. Each of the seven countries involved in the project include a brief update. As the opening of the observatories nears, in this issue is a description of the mechanism to submit proposals for the use of the telescope.
CASI
Adaptive Optics; International Cooperation; Telescopes; Infrared Telescopes; Infrared Astronomy; Gemini Project

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ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20000014459 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Implications of a New Solar System Population of Neutralinos on Indirect Detection Rates
Bergstroem, Lars, Stockholm Univ., Sweden; Damour, Thibault, Institut des Hautes Etudes Scientifiques, France; Edsjoe, Joakim, Stockholm Univ., Sweden; Krauss, Lawrence M., Case Western Reserve Univ., USA; Ullio, Piero, Stockholm Univ., Sweden; May 21, 1999; 18p; In English
Contract(s)/Grant(s): NAS8-38225
Report No.(s): PB2000-100750; IHES/P/99/39; CWRU-P19-99; hep-ph/9905446; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Recently, a new Solar System population of weakly interacting massive particle (WIMP) dark matter has been proposed to exist. We investigate the implications of this population on indirect signals in neutrino telescopes (due to WIMP annihilations in the Earth) for the case when the WIMP is the lightest neutralino of the MSSM, the minimal supersymmetric extension of the standard model. The velocity distribution and capture rate of this new population is evaluated and the flux of neutrino-induced muons from the center of the Earth in neutrino telescopes is calculated. The strength of the signal is very sensitive to the velocity distribution of the new population. We analytically estimate this distribution using the approximate conservation of the component of the WIMP angular momentum orthogonal to the ecliptic plane. The non-linear problem of combining a fixed capture rate from the standard galactic WIMP population with one rising linearly with time from the new population to obtain the present-day annihilation rate in the Earth is also solved analytically. We show that the effects of the new population can be crucial for masses below around 150 GeV, where enhancements of the predicted muon flux from the center of the Earth by up to a factor of 100 compared to previously published estimates occur. As a result of the new WIMP population, the next generation of neutrino telescopes should be able to probe a much larger region of parameter space in the mass range 60-130 GeV.
Author (NTIS)
Neutrinos; Telescopes; Solar System; Populations; Dark Matter; Population Iii Stars; Weakly Interacting Massive Particles

20000018000 National Optical Astronomy Observatories, Tucson, AZ USA
Coma Morphology Due to an Extended Active Region and Implications for the Spin State of Comet Hale-Bopp
Samarasinha, Nalin H., National Optical Astronomy Observatories, USA; January 2000; 10p; In English
Report No.(s): NOAO-Preprint-862; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We show that the circular character of continuum structures observed in the coma of comet Hale-Bopp around the perihelion passage is most likely due to a dust jet from a large extended active region on the surface. Coma morphology due to a wide jet is different from that due to a narrow jet. The latter shows foreshortening effects due to observing geometry, wider jet produces more circular features. This circularization effect provides a self-consistent explanation for the evolution of near-perihelion coma morphology. No changes in the direction of the rotational angular momentum vector are required during this period in contrast to the models of Schleicher et al. This circularization effect also enables us to produce near-circular coma features in the S-E quadrant during 1997 late February and therefore questions the basic premise on which Sekanina bases his morphological arguments for a gravitationally bound satellite nucleus.
Author
Hale-Bopp Comet; Morphology; Comet Heads; Comet Nuclei; Angular Momentum

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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.

20000015386 NASA Kennedy Space Center, Cocoa Beach, FL USA
Galileo Space Probe News Conference, Part 3
Jan. 22, 1996; In English; Videotape: 25 min., 52 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000001075; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

This NASA Kennedy Space Center (KSC) video release presents Part 3 of a press conference from Ames Research Center (ARC) regarding the successful entry of the Galileo Space Probe into Jupiter's atmosphere. The press conference panel is comprised of twelve principal investigators and project scientists that oversee the Galileo mission. The press conference question and answer period is continued from Part 2. Atmospheric thermal structure, water abundances, wind profiles, radiation, cloud structure, chemical composition, and electricity are among the topics discussed. The question and answer period is followed by a presentation in which all of the visuals that are shown during the press conference are reviewed. The video ends with several animations depicting the entry of the probe, descent, and the first measurements of the Jovian atmosphere, historical footage of the building of the probe, and a short interview with Dr. Richard Young (Galileo Probe Scientist, ARC). Parts 1 and 2 of the press conference can be found in document numbers NONP-NASA-VT-2000001073, and NONP-NASA-VT-2000001074.
CASI
Galileo Project; Galileo Probe; Jupiter Atmosphere

20000015387 NASA Kennedy Space Center, Cocoa Beach, FL USA
Galileo Space Probe News Conference, Part 2
Jan. 22, 1996; In English; Videotape: 1 hr., 4 min., 41 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000001074; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS
This NASA Kennedy Space Center (KSC) video release presents Part 2 of a press conference regarding the successful entry of the Galileo Space Probe into Jupiter's atmosphere. The press conference panel is comprised of twelve principal investigators and project scientists that oversee the Galileo mission. The press conference question and answer period is continued from Part 1. Atmospheric thermal structure, water abundances, wind profiles, and electricity are among the topics discussed. The question and answer period is followed by a 3 minute presentation in which all of the visuals that are shown during the press conference are reviewed. Parts 1 and 3 of the press conference can be found in document numbers NONP-NASA-VT-2000001073, and NONP-NASA-VT-2000001075.
CASI
Galileo Project; Galileo Probe; Jupiter Atmosphere

20000015388 NASA Kennedy Space Center, Cocoa Beach, FL USA
Galileo Space Probe News Conference, Part 1
Jan. 22, 1996; In English; Videotape: 1 hr., 2 min., 26 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000001073; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS
This NASA Kennedy Space Center (KSC) video release presents Part 1 of a press conference regarding the successful entry of the Galileo Space Probe into Jupiter's atmosphere. The press conference panel is comprised of twelve principal investigators and project scientists that oversee the Galileo mission. Among these panelists, William J. O'Neil (Jet Propulsion Lab.) begins the video praising all of the scientists that worked on the orbiter mission. He then presents a visual overview of Galileo's overall mission trajectory and schedule. Marcie Smith (NASA Ames Research Center) then describes the Galileo Probe mission and the overall engineering and data acquisition aspects of the Probe's Jupiter atmospheric entry. Dr. Richard Young (NASA Ames Research Center) follows with a brief scientific overview, describing the measurements of the atmospheric composition as well as the instruments that were used to gather the data. Atmospheric pressure, temperature, density, and radiation levels of Jupiter were among the most important parameters measured. It is explained that these measurements would be helpful in determining among other things, the overall dynamic meteorology of Jupiter. A question and answer period follows the individual presentations. Atmospheric thermal structure, water abundances, wind profiles, radiation, cloud structure, chemical composition, and electricity are among the topics discussed. Parts 2 and 3 of the press conference can be found in document numbers NONP-NASA-VT-2000001074, and NONP-NASA-VT-2000001075.
CASI
Galileo Project; Galileo Probe; Atmospheric Entry

20000020950 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Galileo Update: The Search for Water in Jupiter's Atmosphere
Jun. 05, 1997; In English; Videotape: 1 hr. 12 min. 8 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000008140; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS
This videotape presents a panel discussion press conference about the attempts to discover if there is moisture in the atmosphere of Jupiter. David Seidel, of the Jet Propulsion Laboratory (JPL) moderates the discussion. The panel consists of Andrew Ingersoll, California Institute of Technology, Tobias Owen, of the University of Hawaii, Glenn Orton, Robert Carlson of JPL, and Ashwin Vasavada, a graduate student at Cal Tech. Each of the panelists discusses evidence for moisture in Jupiter's

atmosphere. They show video tapes of either animation or shots from the Galileo mission or diagrams of the atmosphere of Jupiter. The videos clips that are shown, include a brief summary of the Galileo mission. A diagram showing the layers of Jupiter's atmosphere is discussed. One panelist discusses and shows shots from the nightside of Jupiter. Another video clip shows evidence for convergence downdrafts around dry spots. Evidence for thunderstorms and updrafts is also reviewed. Shots of the giant red spot on Jupiter are shown, and explanations are given as to what it may be.
CASI
Galileo Project; Jupiter Atmosphere; Moisture; Jupiter (Planet); Vertical Air Currents; Atmospheric Circulation

20000020971 Swedish Inst. of Space Physics, Kiruna, Sweden
ENA Imaging of Planetary Magnetospheres
Brandt, Pontus C:son, Swedish Inst. of Space Physics, Sweden; October 1999; ISSN 0284-1703; 170p; In English; See also 20000020972 through 20000020978; Original contains color illustrations
Report No.(s): IRF-SR-259; ISBN 91-7191-715-2; Copyright; Avail: Issuing Activity, Hardcopy

The PhD thesis focuses on energetic neutral atom (ENA) imaging of the magnetospheres of the Earth and Mercury. ENAs are produced when energetic, singly and positively charged ions charge exchange with neutral atoms. Their neutrality allows them to travel in essentially straight lines unaffected by electric and magnetic fields. ENAs can therefore be used to remotely image space plasma. Observations by the ENA imager PIPPI have been analyzed and are presented. The observations show ENA images of the low-altitude (approx. 500 km) ring current, in the energy range 13-52 keV. and of the ionospheric outflow, in the energy range 0.1-10 keV. PIPPI was carried by the Swedish microsatellite Astrid launched in to a 1000 km circular. polar orbit in January, 1995. Terrestrial ENA sources, such as the ring current, ionospheric outflow, and plasma sheet are reviewed. ENA images of Mercury have been simulated using a model of the magnetosphere and exosphere. The images show strong ENA fluxes of 10(exp 4)/(sq cm sr s kev) close to the surface of the planet, both on the dayside and nightside. Specific expected ENA signatures reflecting the extreme nature of the Hermean magnetosphere are discussed. The obtained results are used to define requirements for an ENA instrument measuring ENAs with sufficient time, resolution.
Author
Neutral Atoms; Imaging Techniques; Space Plasmas; Planetary Magnetospheres; Electric Fields; Charge Exchange

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SOLAR PHYSICS

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

20000017916 Alabama Univ., Huntsville, AL USA
Solar Physics Investigations
Tandberg-Hanssen, Einar, Alabama Univ., USA; Spacelab Science Results Study; Aug. 18, 1999; Volume 1, pp. 14-25; In English; See also 20000017914; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Seven different solar physics experiments have been flown on the Spacelab facility. In the following we shall refer to them by their acronymes as follows: ACRIM - Active Cavity Radiometer Irradiance Monitor. The primary objective is to determine the degree and direction of possible fluctuations in the sun's total output of optical energy (x-rays to microwave wavelengths)by measuring the total solar optical irradiance outside the earth's atmosphere. SUSIM - Solar Ultraviolet Spectral Irradiance Monitor. The objective is to determine both long-term and short-term variations of the total ultraviolet flux emitted by the sun. SOLSPEC - Solar Spectrum Measurement from 180 to 3200 Nanometers. The objective is to measure the solar energy in the ultraviolet, visible and infrared parts of the spectrum, and to determine the amounts of energies in this spectral irradiance, and how they change with time. SOLCON - Measurement of the Solar Constant. The purposes are to measure the absolute value of the total solar irradiance and to detect and measure long-term variations that may exist in its absolute value. SOUP - Solar Optical Universal Polarimeter. The objectives of the experiment are: to measure magnetic and velocity fields in the solar atmosphere; to follow the evolution of solar magnetic structures over periods of several days to determine how magnetic elements couple to the supergranula velocity patterns and by what mechanisms field diffusion and disappearance occur; to study with high temporal and spatial resolution the magnetic field changes associated with transient events; and to provide a test of the pointing accuracy and stability of the Instrument Pointing System (IPS) to sub-arc second accuracy. CHASE - Coronal Helium Abundance Spacelab Experiment. The goal of this experiment is to determine accurately the helium abudance of sun. HRTS Solar Ultraviolet High Resolution Telescope and Spectrograph. Purpose: to investigate the energy transport and mass balance of the temperature minimum, chromosphere, transition zone, and corona in the quiet sun as well as in plages, flares and sunspots; to study the velocity field of

the lower corona in order to investigate the origin of the solar wind; to investigate the structure of spicules and superspicules; to investigate the structure and dynamics of prominences; and to study the preflare and flare phenomena.
CASI
Solar Atmosphere; Solar Energy; Solar Physics; Solar Prominences; Irradiance; Infrared Spectra; Magnetic Field Configurations; Sun

20000017922 California Univ., San Diego, La Jolla, CA USA
Coronal Reconstruction using LASCO and UVCS Observations
Hick, P. P., California Univ., San Diego, USA; [2000]; 11p; In English
Contract(s)/Grant(s): NAG5-7295; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The main goal of the research described in the original proposal was to develop methods to quantify coronal and inner-heliospheric velocity fields of the 'quiet' solar wind. For this we planned to use several sources of observations:(1) SOHO/UVCS velocity information in the range 1.5-3 Solar Radii obtained from Doppler dimming observations; (2) projected solar wind velocities (into the plane of the sky) obtained from SOHO/ LASCO images (1.1-30 Solar Radii), primarily derived from two-dimensional correlation tracking techniques; (3) Interplanetary scintillation observations of the heliospheric (> 26 Solar Radii) solar wind velocity from the Solar-Terrestrial Environment Laboratory (STELab) in Nagoya, Japan; (4) Ecliptic in situ observations: data for the ecliptic solar wind are available from the MIT and Los Alamos plasma experiments on the Earth-orbiting IMP-8 spacecraft, from the Cellas instrument on SOHO near the LI Lagrange point, and from the WIND spacecraft; (5) Out-of-ecliptic in situ observations: these data are available primarily from the Los Alamos SWOOPS instrument on Ulysses, which passed over the solar north pole in August 1995, about one year prior to the Whole Sun Month period. Where ever possible we planned to use the first Whole Sun Month as the main time period for the analysis, since we expected that for this period it would be easiest to obtain adequate coverage over the extended period of time required to analyze 'quiet' solar wind patterns. Beyond the observations mentioned above (primarily SOHO data) we extended our selection of data to several events identified in the Yohkoh/SXT data base which directly promised to provide us with clues about the connection between the slow solar wind observed by IPS in the inner heliosphere and their sources in the low corona, in particular active regions. We also obtained valuable results using SWOOPS ill situ observations from the pole-to-pole passage of Ulysses in a comparison with solar wind velocities derived from a tomographic reconstruction of Nagoya IPS observations.
Author
Solar Wind; Solar Wind Velocity; Sun; Magnetohydrodynamic Flow; Coronal Mass Ejection; Solar Corona; Heliosphere; Solar X-Rays

20000017989 Swedish Inst. of Space Physics, Uppsala, Sweden
Solar Wind Control of the Tail Lobe Magnetic Field Based on ISEE-1/2 and IMP-8 Data
Karlsson, S. B. P., Swedish Inst. of Space Physics, Sweden; Tsyganeko, N. A., NASA Goddard Space Flight Center, USA; June 1999; ISSN 0284-1703; 31p; In English; Sponsored in part by Anna Maria Lundin Scholarship
Report No.(s): IRF-SR-261; Copyright; Avail: Issuing Activity, Hardcopy

Plasma data from the ISEE-1 and -2 spacecraft during 1977-1980 have been used to determine the distribution of data points in the magnetotail in the range of distances -20 less than X(sub GSM) less than -15, i.e. which of the records that were located in the current sheet, in the tail lobe, in the magnetosheath and in the boundary layers respectively. The ISEE-1 and -2 magnetic field data for the records in the tail lobe were then used to model the tail lobe magnetic field dependence on the solar wind dynamic pressure, on the Interplanetary Magnetic Field (IMF) and on the Dst index. The tail lobe magnetic field was assumed to be dependent on the square root of the dynamic pressure based on the balance between the total magnetic pressure in the tail lobes and the dynamic pressure of the solar wind. The IMF dependent terms, added to the pressure term, were sought in many different forms while the Dst dependence of the tail lobe magnetic field was assumed to be linear. The field shows a strong dependence on the square root of the dynamic pressure and the different IMF dependent terms all constitute a significant contribution to the total field. However, the dependence on the Dst index turned out to be very weak at those down-tail distances. The results of this study are intended to be used for parameterizing future version of the data-based models of the global magnetospheric magnetic field.
Author
Solar Wind; Wind Pressure; Plasmas (Physics); Dynamic Pressure; Interplanetary Magnetic Fields

20000019581 National Optical Astronomy Observatories, Tucson, AZ USA

Solar-Cycle Changes in GONG P-Mode Widths and Amplitudes 1995-1998

Komm R. W., National Solar Observatory, USA; Howe, R., National Solar Observatory, USA; Hill, F., National Solar Observatory, USA; November 1999; 42p; In English

Contract(s)/Grant(s): NASA Order S-92698-F; NAG5-3077

Report No.(s): NOAO-Preprint-860; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We search for a solar cycle variation in mode widths and amplitudes derived from 3-month GONG time series. The variation of mode width and amplitude observed in GONG data are the combined effects of fill factor, temporal variation, and measurement uncertainties. The largest variation is caused by the fill factor resulting in modes with increased width and reduced amplitude when fill is lower. We assume that the solar cycle variation is the only other systematic variation beside the temporal window function effect. We correct all currently available data sets for the fill factor and simultaneously derive the solar cycle variation. We find an increase of about 3% on average in mode width from the previous minimum to Oct. 1998 and a decrease of about 7% and 6% in mode amplitude and mode area (width x amplitude). We find no l dependence of the solar-cycle changes. As a function of frequency, these changes show a maximum between 2.7 and 3.3 mHz with about 47% higher than average values for mode width and about 29% and 36% higher ones for mode amplitude and area. We estimate the significance of these rather small changes by a pre-whitening method and find that the results are significant at or above the 99.9% level with mode area showing the highest level of significance and mode width the lowest. The variation in background amplitude is most likely not significant and is consistent with a zero change.

Author

Solar Cycles; Solar Oscillations; Sun; Solar Activity

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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 52 Aerospace Medicine. For theory see 73 Nuclear Physics.

20000014437 Helsinki Univ. of Technology, Metsahovintie Observatory, Kylmaelae, Finland

Total Flux Density Variations in Extragalactic Radio Sources: Observations and Analysis

Lahteenmaki, Anne, Helsinki Univ. of Technology, Finland; Metsahovi Publications on Radio Science; 1999; ISSN 1455-9587; 40p; In English

Report No.(s): PB2000-100780; HUT-MET-31; ISBN 951-22-4526-4; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

This doctoral thesis presents observations and analysis of extragalactic radio sources. The sources in question are radio-load active galactic nuclei, namely quasars, BL Lac objects and radio galaxies. They were observed at high radio frequencies and in gamma-rays. The radio observations were then analyzed by model fitting and statistical methods, and further compared with the gamma-ray data. The aim was to study individual source properties as well as the properties of classes of sources.

Author (NTIS)

Flux Density; Extragalactic Radio Sources; Active Galactic Nuclei; BL Lacertae Objects; Quasars; Radio Galaxies; Radio Astronomy

20000017924 NASA Goddard Space Flight Center, Greenbelt, MD USA

Space Environment Effects: Model for Emission of Solar Protons (ESP)--Cumulative and Worst-Case Event Fluences

Xapsos, M. A., Naval Research Lab., USA; Barth, J. L., NASA Goddard Space Flight Center, USA; Stassinopoulos, E. G., NASA Goddard Space Flight Center, USA; Burke, Edward A., Burke (Edward A.), USA; Gee, G. B., SGT, Inc., USA; December 1999; 32p; In English

Report No.(s): NASA/TP-1999-209763; M-952; NAS 1.60:209763; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects that solar proton events have on microelectronics and solar arrays are important considerations for spacecraft in geostationary and polar orbits and for interplanetary missions. Designers of spacecraft and mission planners are required to assess the performance of microelectronic systems under a variety of conditions. A number of useful approaches exist for predicting information about solar proton event fluences and, to a lesser extent, peak fluxes. This includes the cumulative fluence over the course of a mission, the fluence of a worst-case event during a mission, the frequency distribution of event fluences, and the frequency distribution of large peak fluxes. Naval Research Laboratory (NRL) and NASA Goddard Space Flight Center, under the sponsorship of NASA's Space Environments and Effects (SEE) Program, have developed a new model for predicting

cumulative solar proton fluences and worst-case solar proton events as functions of mission duration and user confidence level. This model is called the Emission of Solar Protons (ESP) model.
Author
Solar Protons; Aerospace Environments; Mathematical Models; Environment Models; Solar Arrays; Extraterrestrial Radiation; Radiation Effects

20000017959 New Hampshire Univ., Durham, NH USA
COMPTEL Studies of Gamma-Ray Bursts at MeV Energies ***Final Report, 1 Dec. 1998 - 30 Nov. 1999***
McConnell, Mark L., New Hampshire Univ., USA; Nov. 09, 1999; 13p; In English
Contract(s)/Grant(s): NAG5-7829; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this program was to analyse and interpret gamma-ray burst (GRB) data using both telescope mode data and single detector burst mode data from COMPTEL. Collectively, these data span the energy range from 300 keV up to 30 MeV. The initial goal of our proposal was to perform a standard analysis for each significant GRB event seen by COMPTEL. This includes GRBs that are registered by the telescope mode data as well as GRBs that are registered only in the burst mode data. (The latter category includes both GRBs that he outside of the FoV as well as GRBs within the FoV that are too weak to be seen in the telescope mode.) A second goal of our proposal was to define a set of data products (including deconvolved photon spectra) that, for each detected GRB event, would be made available via the COMPTEL GRB Web Page. The third goal of our program was to perform more detailed studies of selected GRB events. This represented a continuation of past GRB studies by the COMPTEL team. In general, we have met with only limited success in achieving these goals, in part due to the limited resources provided and our philosophy of utilizing local high school students to participate in this effort. Using local high school student support, however, we expect that considerable progress will be made in our efforts to catalog the COMPTEL gamma-ray burst data between now and the end of the current academic year. In addition, observations with COMPTEL contributed to an analysis of GRB 990123, the first gamma-ray burst with simultaneous optical observations.
Author
Gamma Ray Bursts; Spaceborne Astronomy; Gamma Ray Astronomy; Cosmic X Rays

20000018002 Smithsonian Astrophysical Observatory, Cambridge, MA USA
Beamed and Unbeamed X-Ray Emission in FR1 Radio Galaxies ***Final Report, 15 Feb. 1992 - 30 Sep. 1999***
Worrall, Diana M., Smithsonian Astrophysical Observatory, USA; January 2000; 3p; In English
Contract(s)/Grant(s): NAG5-1882; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The research exploited ROSAT's sensitivity, together with its spatial and spectral resolution, to separate X-ray emission components in the sources. Prior to ROSAT, the dominant X-ray emission mechanism in radio galaxies as a class was unclear, with correlations between the X-ray and radio emission used on one hand to argue for a nuclear origin for the X-rays, and on the other hand for a thermal origin. Our observations (normally between 10 and 25 ks in length) routinely detected the target sources, and demonstrated that both resolved (thermal) and unresolved X-ray emission are typically present. Highlights of our work included two of the first detections of high-power radio galaxies at high redshift, 3C 280 and 3C 220.1. When combined with the work of two other groups, we find that of the 38 radio galaxies at z is greater than 0.6 in the 3CRR sample, 12 were observed in ROSAT pointed observations and 9 were detected with the four most significant detections exhibiting source extent, including 3C 280 and 3C 220.1. Moreover, we discovered extended emission around five 3CRR quasars at redshift greater than about 0.4, one of which is at z is greater than 0.6. Unification predicts that the X-ray environments of powerful radio galaxies and quasars should be similar, and our results show that powerful radio sources are finding some of the highest-redshift X-ray clusters known to date, pointing to deep gravitational potential wells early in the Universe.
Derived from text
Radio Galaxies; Red Shift; X Ray Astronomy; X Ray Sources; Cosmic X Rays; Radio Sources (Astronomy)

20000019648 NASA Marshall Space Flight Center, Huntsville, AL USA
Statistical Properties of SGR 1806-20 Bursts
Gogus, E.; Woods, P.; Kouveliotou, C.; VanParadijs, J.; Briggs, M. S.; Duncan, R. C.; Thompson, C.; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

We find that the fluence distribution of bursts observed with each instrument are well described by power laws with indices 1.43, 1.67 and 1.76 respectively. The distribution of time intervals between successive bursts from SGR 1806-20 is described by a lognormal function with peak at 97 s. There is no correlation between burst intensity and either the waiting times till the next burst or the time elapsed since the previous burst, We find a correlation between the duration and fluence of the bursts, but with substantial scatter. In all these statistical properties, SGR bursts resemble self-organized critical systems, such as earthquakes and

solar flares. Our results thus support the hypothesis that the energy source for SGR bursts is crustquakes due to the magnetic field of the neutron star, rather than any accretion- or nuclear-power.
Author
Soft Gamma Repeaters; Starquakes; Gamma Ray Bursts; Gamma Ray Astronomy; Stellar Activity

20000019652 NASA Marshall Space Flight Center, Huntsville, AL USA
Detection of X-Ray Pulsations from the Be/X-Ray Transient A 0535+26 During a Disc Loss Phase of the Primary
Negueruela, Ignacio, Nuova Telespazio, Italy; Reig, Pablo, Foundation for Research and Technology-Hellas, Iraklion, Greece; Finger, Mark H., NASA Marshall Space Flight Center, USA; Roche, Paul, Leicester Univ., UK; [1999]; 1p; In English; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Using the RossiXTE experiment, we detect weak X-ray emission from the recurrent Be/X-ray transient A 0535+26 at a time when the optical counterpart V725 Tau displayed H.alpha in absorption, indicating the absence of a circumstellar disc. The X-ray radiation is strongly modulated at the 103.5-s pulse period of the neutron star, confirming that it originates from A 0535+26. The source is weaker than in previous quiescence detections by two orders of magnitude and should be in the centrifugal inhibition regime. We show that the X-ray luminosity cannot be due to accretion on to the magnetosphere of the neutron star. Therefore this detection represents a new state of the accreting pulsar. We speculate that the X-ray emission can be due to some matter leaking through the magnetospheric barrier or thermal radiation from the neutron star surface due to crustal heating. The detection of the X-ray source in the inhibition regime implies a reduced density in the outflow from the Be companion during its disc-less phase.
Author
X Rays; Beryllium; X Ray Binaries; Neutron Stars; Pulsars; Stellar Envelopes; Stellar Magnetospheres

20000020780 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-37: Gamma Ray Observatory
Jan. 29, 1991; In English; Videotape: 16 min. 2 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000013426; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

This NASA Kennedy Space Center (KSC) video release presents footage of pre-flight activities involving the STS-37 primary payload, the Gamma Ray Observatory (GRO). The GRO is shown being removed from the transport aircraft to one of the runways at Kennedy. Other footage includes Kennedy work crews moving the GRO into position as well as discussions between the STS-37 astronauts and the work crews regarding GRO operation.
CASI
Gamma Ray Observatory; Cape Kennedy Launch Complex

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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.

20000018006 NASA, Washington, DC USA
Aeronautics and Space Report of the President: Fiscal Year 1998 Activities, *1 Oct. 1997 - 30 Sep. 1998*
[1999]; 106p; In English; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The National Aeronautics and Space Act of 1958 directed the annual Aeronautics and Space Report to include a ”comprehensive description of the programmed activities and the accomplishments of all agencies of the United States in the field of aeronautics and space activities during the preceding calendar year. In recent years, the reports have been prepared on a fiscal year (FY) basis, consistent with the budgetary period now used in programs of the Federal Government. This year’s report covers activities that took place from October 1, 1997, through September 30, 1998. The activities of agencies included are NASA, the Department of Defense, The Federal Aviation Administration, the Department of Commerce, the Department of the Interior, the Federal Communications Commission, the Department of Agriculture, the National Science Foundation, the Department of State, the Department of Energy, the Smithsonian Institution, the Arms Control and Disarmament Agency, the Environmental Protection Agency, and the U.S. Information Agency. Appendices cover the U.S. Government Spacecraft Record, World Record of Space Launches Successful in Attaining Earth Orbit or Beyond , Successful Launches to Orbit on U.S. Launch Vehicles, October 1, 1997-September 30, 1998, U.S. and Russian Human Space Flights, 1961-September 30, 1998, U.S. Space Launch Vehicles, Space

Activities of the U.S. Government-Historical Budget Summary, Space Activities of the U.S. Government-Budget Authority in Equivalent FY 1998 Dollars, Federal Space Activities Budget, Federal Aeronautics Budget, and a glossary
Derived from text
Presidential Reports; Space Programs; Manned Space Flight; Space Missions; NASA Programs; Aerospace Sciences; General Overviews

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