National Aeronautics and
Space Administration
Langley Research Center

Scientific and Technical
Information Program Office

Scientific and Technical Aerospace Reports

STAR

Volume 41 Issue 9

May 2, 2003

WHAT'S INSIDE

- NASA STI Program Overview
- Introduction
- NASA STI Availability Information
- Table of Contents
- Subject Term Index
- Personal Author Index

NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program plays a key part in helping NASA maintain this important role.

The NASA STI Program provides access to the NASA STI Database, the largest collection of aeronautical and space science in the world. The STI Program is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or major significant phases of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but has less stringent limitations on manuscript length and extent of graphic presentations.
- TECHNICAL MEMORANDUM. Scientific and technical findings that are of preliminary or specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.
- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that help round out the STI Program's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results ... even providing videos.

The NASA STI Program is managed by the NASA STI Program Office (STIPO). STIPO is the administrative office at Langley Research Center for the NASA STI Program.

For more information about the NASA STI Program, you can:

- Access the NASA STI Program Home Page at *http://www.sti.nasa.gov*
- E-mail your question via the Internet to *help@sti.nasa.gov*
- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Telephone the NASA STI Help Desk at (301) 621-0390
- Write to:
  NASA STI Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

Introduction

Scientific and Technical Aerospace Reports (*STAR*) is an online information resource listing citations and abstracts of NASA and world wide aerospace-related STI. Updated biweekly, *STAR* highlights the most recent additions to the NASA STI Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related Research & Development (R&D) results.

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

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

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

The NASA STI Program

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

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

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

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

NASA STI Availability Information

NASA Center for AeroSpace Information (CASI)

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

Each citation in *STAR* indicates a 'Source of Availability'. When CASI is indicated, the user can order this information directly from CASI using the STI Online Order Form or contact help@sti.nasa.gov or telephone the CASI Help Desk at 301-621-0390. Before ordering you may access price code tables for STI documents and videos. When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

National Technical Information Service (NTIS)

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

The Federal Depository Library Program (FDLP)

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

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

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

Table of Contents

Subject Divisions/Categories

Document citations are grouped by division and then by category, according to the *NASA Scope and Coverage Category Guide.*

Aeronautics

01 Aeronautics (General) 1
02 Aerodynamics 1
05 Aircraft Design, Testing and Performance 4
07 Aircraft Propulsion and Power 6
08 Aircraft Stability and Control 7
09 Research and Support Facilities (Air) 9

Astronautics

12 Astronautics (General) 9
13 Astrodynamics 11
14 Ground Support Systems and Facilities (Space) 11
15 Launch Vehicles and Launch Operations 12
16 Space Transportation and Safety 13
17 Space Communications, Spacecraft Communications, Command and Tracking 13
18 Spacecraft Design, Testing and Performance 17
19 Spacecraft Instrumentation and Astrionics 25
20 Spacecraft Propulsion and Power 28

Chemistry and Materials

23 Chemistry and Materials (General) 32
24 Composite Materials 33
25 Inorganic, Organic and Physical Chemistry 37
26 Metals and Metallic Materials 39
27 Nonmetallic Materials 42
28 Propellants and Fuels 43
29 Space Processing 44

Engineering

31 Engineering (General) 44
32 Communications and Radar 45
33 Electronics and Electrical Engineering 46
34 Fluid Mechanics and Thermodynamics 48
35 Instrumentation and Photography 51

37 Mechanical Engineering 54
38 Quality Assurance and Reliability 55
39 Structural Mechanics 56

Geosciences

42 Geosciences (General) 58
43 Earth Resources and Remote Sensing 58
44 Energy Production and Conversion 64
46 Geophysics 64
47 Meteorology and Climatology 72
48 Oceanography 94

Life Sciences

51 Life Sciences (General) 94
53 Behavioral Sciences 95
54 Man/System Technology and Life Support 96
55 Exobiology 96

Mathematical and Computer Sciences

59 Mathematical and Computer Sciences (General) 97
60 Computer Operations and Hardware 98
61 Computer Programming and Software 98
62 Computer Systems 103
63 Cybernetics, Artificial Intelligence and Robotics 103
64 Numerical Analysis 104
65 Statistics and Probability 105
66 Systems Analysis and Operations Research 105
67 Theoretical Mathematics 105

Physics

70 Physics (General) 106
71 Acoustics 107
74 Optics 107
76 Solid-State Physics 109
77 Physics of Elementary Particles and Fields 111

Social and Information Sciences

80 Social and Information Sciences (General) 112
81 Administration and Management 113
82 Documentation and Information Science 114
83 Economics and Cost Analysis 114
85 Technology Utilization and Surface Transportation 115

Space Sciences

88 Space Sciences (General) 115
89 Astronomy 116
90 Astrophysics 119
91 Lunar and Planetary Science and Exploration 128
92 Solar Physics 131
93 Space Radiation 131

General

99 General 132

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 linking to the corresponding document citation from *NASA Thesaurus* terms and personal author names.

Subject Term Index

Personal Author Index

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

A Biweekly Publication of the National Aeronautics and Space Administration

VOLUME 41, MAY 2, 2003

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*.

20030025771 Georgia Inst. of Tech., Atlanta, GA, USA
Exploration of Advanced Probabilistic and Stochastic Design Methods
Marvis, Dimitri N.; DeLaurentis, Dan; Kirby, Michelle R.; March 31, 2003; In English; CD-ROM contains report in Word and PDF format and related files
Contract(s)/Grant(s): NAG-1-2235; No Copyright; Avail: CASI; C01, CD-ROM

The primary objective of the three year research effort was to explore advanced, non-deterministic aerospace system design methods that may have relevance to designers and analysts. The research pursued emerging areas in design methodology and leverage current fundamental research in the area of design decision-making, probabilistic modeling, and optimization. The specific focus of the three year investigation was oriented toward methods to identify and analyze emerging aircraft technologies in a consistent and complete manner, and to explore means to make optimal decisions based on this knowledge in a probabilistic environment. The research efforts were classified into two main areas. First, Task A of the grant has had the objective of conducting research into the relative merits of possible approaches that account for both multiple criteria and uncertainty in design decision-making. In particular, in the final year of research, the focus was on the comparison and contrasting between three methods researched. Specifically, these three are the Joint Probabilistic Decision-Making (JPDM) technique, Physical Programming, and Dempster-Shafer (D-S) theory. The next element of the research, as contained in Task B, was focused upon exploration of the Technology Identification, Evaluation, and Selection (TIES) methodology developed at ASDL, especially with regards to identification of research needs in the baseline method through implementation exercises. The end result of Task B was the documentation of the evolution of the method with time and a technology transfer to the sponsor regarding the method, such that an initial capability for execution could be obtained by the sponsor. Specifically, the results of year 3 efforts were the creation of a detailed tutorial for implementing the TIES method. Within the tutorial package, templates and detailed examples were created for learning and understanding the details of each step. For both research tasks, sample files and tutorials are attached in electronic form with the enclosed CD.
Derived from text
Aerospace Engineering; Probability Theory; Stochastic Processes; Methodology; Systems Engineering

02
AERODYNAMICS

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

20030022753 Science Applications International Corp., Moffett Field, CA, USA
Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients
Korsmeyer, David, Technical Monitor; Rajkumar, T.; Bardina, Jorge; [2002]; 12 pp.; In English; AeroSense 2003: SPIE's 17th Annual International Symposium on Aerospace/Defense Sensing, Simulation and Controls, 21-25 Apr. 2003, Orlando, FL, USA; Copyright; Avail: CASI; A03, Hardcopy

Basic aerodynamic coefficients are modeled as functions of angle of attack, speed brake deflection angle, Mach number, and side slip angle. Most of the aerodynamic parameters can be well-fitted using polynomial functions. We previously

demonstrated that a neural network is a fast, reliable way of predicting aerodynamic coefficients. We encountered few under fitted and/or over fitted results during prediction. The training data for the neural network are derived from wind tunnel test measurements and numerical simulations. The basic questions that arise are: how many training data points are required to produce an efficient neural network prediction, and which type of transfer functions should be used between the input-hidden layer and hidden-output layer. In this paper, a comparative study of the efficiency of neural network prediction based on different transfer functions and training dataset sizes is presented. The results of the neural network prediction reflect the sensitivity of the architecture, transfer functions, and training dataset size.
Author
Aerodynamic Coefficients; Neural Nets; Computer Networks; Predictions; Aerodynamics

20030022774 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, USA
Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade
Devenport, William J.; Spitz, Nicolas; Envia, Edmane, Technical Monitor; March 2003; 16 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG3-2710; WU-708-87-23
Report No.(s): NASA/CR-2003-212099; NAS 1.26:212099; E-13752; No Copyright; Avail: CASI; A03, Hardcopy

Progress on predicting modes of the unsteady velocity/vorticity field of a turbulent boundary layer from Reynolds stress statistics is described. Prediction of these modes, that provide the source terms for trailing edge noise predictions in aircraft engine fans and other configurations, will allow for the first time detailed viscous flow effects to be included in such noise calculations. The key accomplishments of this work in FY02 are: (1) The development of a Matlab code for the prediction of modes in two- and three-dimensional boundary layers, previously applied to plane wakes; (2) Predictions with the code using a constant lengthscale formulation in a fully developed turbulence channel flow. Comparison of these boundary layer predictions with available DNS simulation results; and (3) Formulation of an improved model using a variable lengthscale proportional to mixing length. Turbulent channel flow predictions and comparison with DNS results. This work is being carried out in continuous communication and collaboration with the Glegg research group at Florida Atlantic University, which will be incorporating mode predictions into engine noise calculations.
Author
Vorticity; Aerodynamic Noise; Trailing Edges; Noise Prediction (Aircraft); Turbulent Boundary Layer; Computational Fluid Dynamics; Turbulent Flow; Turbulence Models; Flow Distribution

20030025727 NASA Langley Research Center, Hampton, VA, USA
Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing
Luckring, J. M.; [2003]; 13 pp.; In English; Original contains color illustrations
Report No.(s): AIAA Paper 2003-0753; No Copyright; Avail: CASI; A03, Hardcopy

A 65 deg delta wing has been tested in the National Transonic Facility (NTF) at mean aerodynamic chord Reynolds numbers from 6 million to 120 million at subsonic and transonic speeds. The configuration incorporated a systematic variation of the leading edge bluntness. The analysis for this paper is focused on the Reynolds number and bluntness effects at transonic speeds (M = 0.85) from this data set. The results show significant effects of both these parameters on the onset and progression of leading- edge vortex separation.
Author
Reynolds Number; Blunt Leading Edges; Delta Wings; Airfoil Profiles; Transonic Speed; Wind Tunnel Tests; Vortices

20030025754 NASA Langley Research Center, Hampton, VA, USA
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements
Hall, Robert M.; Woodson, Shawn H.; Chambers, Joseph R.; January 2003; 20 pp.; In English; 41st AIAA Aerospace Sciences Meeting & Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-0927; No Copyright; Avail: CASI; A03, Hardcopy

The Abrupt Wing Stall (AWS) Program has addressed the problem of uncommanded lateral motions, such as wing drop and wing rock, at transonic speeds. The genesis of this Program was the experience of the F/A-18E/F Program in the late 199O's, when wing drop was discovered in the heart of the maneuver envelope for the pre-production aircraft. While the F/A-18E/F problem was subsequently corrected by a leading-edge flap scheduling change and the addition of a porous door to the wing fold fairing, the AWS Program was initiated as a national response to the lack of technology readiness available at the time of the F/A-18E/F Development Program. The AWS Program objectives were to define causal factors for the

F/A-18E/F experience, to gain insights into the flow physics associated with wing drop, and to develop methods and analytical tools so that future programs could identify this type of problem before going to flight test. The paper reviews, for the major goals of the AWS Program, the status of the technology before the program began, the program objectives, accomplishments, and impacts. Lessons learned are presented for the benefit of future programs that must assess whether a vehicle will have uncommanded lateral motions before going to flight test. Finally, recommended future research needs are presented in light of the AWS Program experience.
Author
Wings; Aerodynamic Stalling; Flight Tests; Leading Edges; Flapping

20030031333 NASA Langley Research Center, Hampton, VA, USA
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique
Allison, Dennis O.; Cavallo, Peter A.; January 03, 2003; 52 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): WU 719-10-40-10
Report No.(s): NASA/TP-2003-212156; L-18027; NAS 1.60:212156; No Copyright; Avail: CASI; A04, Hardcopy

An equivalent-plate structural deformation technique was coupled with a steady-state unstructured-grid three-dimensional Euler flow solver and a two-dimensional strip interactive boundary-layer technique. The objective of the research was to assess the extent to which a simple accounting for static model deformations could improve correlations with measured wing pressure distributions and lift coefficients at transonic speeds. Results were computed and compared to test data for a wing-fuselage model of a generic low-wing transonic transport at a transonic cruise condition over a range of Reynolds numbers and dynamic pressures. The deformations significantly improved correlations with measured wing pressure distributions and lift coefficients. This method provided a means of quantifying the role of dynamic pressure in wind-tunnel studies of Reynolds number effects for transonic transport models.
Author
Aeroelasticity; Unstructured Grids (Mathematics); Three Dimensional Flow; Aerodynamic Coefficients; Dynamic Pressure; Pressure Distribution

20030032187 NASA Wallops Flight Center, Wallops Island, VA, USA
An Overview of the NASA Sounding Rocket and Balloon Programs
Eberspeaker, Philip J.; Smith, Ira S.; [2003]; 1 pp.; In English; ESA Symposium, 2-5 Jun. 2003, Switzerland; No Copyright; Avail: Other Sources; Abstract Only

The U.S. National Aeronautics and Space Administration (NASA) Sounding Rockets and Balloon Programs conduct a total of 50 to 60 missions per year in support of the NASA scientific community. These missions support investigations sponsored by NASA's Offices of Space Science, Life and Microgravity Sciences & Applications, and Earth Science. The Goddard Space Flight Center has management and implementation responsibility for these programs. The NASA Sounding Rockets Program provides the science community with payload development support, environmental testing, launch vehicles, and launch operations from fixed and mobile launch ranges. Sounding rockets continue to provide a cost-effective way to make in situ observations from 50 to 1500 km in the near-earth environment and to uniquely cover the altitude regime between 50 km and 130 km above the Earth's surface. New technology efforts include GPS payload event triggering, tailored trajectories, new vehicle configuration development to expand current capabilities, and the feasibility assessment of an ultra high altitude sounding rocket vehicle. The NASA Balloon Program continues to make advancements and developments in its capabilities for support of the scientific ballooning community. The Long Duration Balloon (LDB) is capable of providing flight durations in excess of two weeks and has had many successful flights since its development. The NASA Balloon Program is currently engaged in the development of the Ultra Long Duration Balloon (ULDB), which will be capable of providing flight times up to 100-days. Additional development efforts are focusing on ultra high altitude balloons, station keeping techniques and planetary balloon technologies.
Author
Balloons; NASA Space Programs; Sounding Rockets; General Overviews

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*.

20030022708 Defence Science and Technology Organisation, Fishermans Bend, Australia
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction
Lombardo, D. C.; Fraser, K. F.; June 2002; 22 pp.; In English
Report No.(s): DSTO-TN-0462; DODA-AR-012-522; Copyright; Avail: Other Sources

This paper discusses the need for understanding reliability within the context of helicopter structures and presents a case for why such understanding is essential to successfully implementing better usage monitoring programs.
Author
Fatigue (Materials); Fatigue Life; Helicopters; Reliability Engineering; Reliability Analysis; Performance Prediction; Risk

20030022714 NASA Ames Research Center, Moffett Field, CA, USA
Aerodynamic Shape Optimization using an Evolutionary Algorithm
Hoist, Terry L.; Pulliam, Thomas H.; January 2003; 32 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A method for aerodynamic shape optimization based on an evolutionary algorithm approach is presented and demonstrated. Results are presented for a number of model problems to access the effect of algorithm parameters on convergence efficiency and reliability. A transonic viscous airfoil optimization problem-both single and two-objective variations is used as the basis for a preliminary comparison with an adjoint-gradient optimizer. The evolutionary algorithm is coupled with a transonic full potential flow solver and is used to optimize the inviscid flow about transonic wings including multi-objective and multi-discipline solutions that lead to the generation of pareto fronts. The results indicate that the evolutionary algorithm approach is easy to implement, flexible in application and extremely reliable.
Author
Algorithms; Shape Optimization; Aerodynamic Configurations; Parameterization

20030025280 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy
Koratkar, Anuradha; Grosvenor, Sandy; Jones, Jeremy; Memarsadeghi, Nargess; Wolf, Karl; [2002]; 12 pp.; In English; SPIE 2002, 22-28 Aug. 2002, Waikoloa, HI, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

In the coming decade, the drive to increase the scientific returns on capital investment and to reduce costs will force automation to be implemented in many of the scientific tasks that have traditionally been manually overseen. Thus, spacecraft autonomy will become an even greater part of mission operations. While recent missions have made great strides in the ability to autonomously monitor and react to changing health and physical status of spacecraft, little progress has been made in responding quickly to science driven events. The new generation of space-based telescopes/observatories will see deeper, with greater clarity, and they will generate data at an unprecedented rate. Yet, while onboard data processing and storage capability will increase rapidly, bandwidth for downloading data will not increase as fast and can become a significant bottleneck and cost of a science program. For observations of inherently variable targets and targets of opportunity, the ability to recognize early if an observation will not meet the science goals of variability or minimum brightness, and react accordingly, can have a major positive impact on the overall scientific returns of an observatory and on its operational costs. If the observatory can reprioritize the schedule to focus on alternate targets, discard uninteresting observations prior to downloading, or download them at a reduced resolution its overall efficiency will be dramatically increased. We are investigating and developing tools for a science goal monitoring (SGM) system. The SGM will have an interface to help capture higher-level science goals from scientists and translate them into a flexible observing strategy that SGM can execute and monitor. SGM will then monitor the incoming data stream and interface with data processing systems to recognize significant events. When an event occurs, the system will use the science goals given it to reprioritize observations, and react appropriately and/or communicate with ground systems - both human and machine - for confirmation and/or further high priority analyses.
Author
Telescopes; Proving; Operating Costs; Onboard Data Processing; Data Processing Equipment; Data Flow Analysis; Flight Vehicles

20030025715 NASA Glenn Research Center, Cleveland, OH, USA

Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise

Goldstein, Marvin E.; Envia, E.; [2002]; 24 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

In many cases of technological interest solid boundaries play a direct role in the aerodynamic sound generation process and their presence often results in a large increase in the acoustic radiation. A generalized treatment of the emission of sound from moving boundaries is presented. The approach is similar to that of Ffowcs Williams and Hawkings (1969) but the effect of the surrounding mean flow is explicitly accounted for. The results are used to develop a rational framework for the prediction of internally generated aero-engine noise. The final formulas suggest some new noise sources that may be of practical significance.

Author

Aerodynamic Noise; Aircraft Engines; Engine Noise; Sound Generators

20030032177 Swales Aerospace, Hampton, VA, USA

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts

Millsaps, Gary D.; Yackovetsky, Robert E., Technical Monitor; March 2003; 27 pp.; In English

Contract(s)/Grant(s): NAS1-00135; RTOP 786-40-10-10

Report No.(s): NASA/CR-2003-212170; NAS 1.26:212170; No Copyright; Avail: CASI; A03, Hardcopy

It is acknowledged that the aviation and aerospace industries are primary forces influencing the industrial development and economic well being of the USA and many countries around the world. For decades the US national air transportation system has been the model of success - safely and efficiently moving people, cargo, goods and services and generating countless benefits throughout the global community; however, the finite nature of the system and many of its components is becoming apparent. Without measurable increases in the capacity of the national air transportation system, delays and service delivery failures will eventually become intolerable. Although the recent economic slowdown has lowered immediate travel demands, that trend is reversing and cargo movement remains high. Research data indicates a conservative 2.5-3.0\% annual increase in aircraft operations nationwide through 2017. Such growth will place additional strains upon a system already experiencing capacity constraints. The stakeholders of the system will continue to endure ever-increasing delays and abide lesser levels of service to many lower population density areas of the country unless more efficient uses of existing and new transportation resources are implemented. NASA s Small Aircraft Transportation System program (SATS) is one of several technologies under development that are aimed at using such resources more effectively. As part of this development effort, this report is the first in a series outlining the findings and recommendations resulting from a comprehensive program of multi-level analyses and system engineering efforts undertaken by NASA Langley Research Center s Systems Analysis Branch (SAB). These efforts are guided by a commitment to provide systems-level analysis support for the SATS program. Subsequent efforts will build upon this early work to produce additional analyses and benefits studies needed to provide the technical and economic basis for national investment and policy decisions related to further development and potential deployment of a small aircraft transportation system. This report primarily serves two purposes. First, it presents results attained from an initial evaluation and analysis of the Higher Volume Operations (HVO) and EnRoute Operations (ERO) concepts - both designated operational capabilities within the SATS Program s Concept of Operations (CONOPS) document. It further outlines areas of the concepts that would benefit from follow-on analyses and system engineering efforts. It is intended that these processes will aid continued maturation of the concepts and promote additional studies of their effects and influences in combination with other designated CONOPS currently under development. In essence, it establishes a baseline of data upon which subsequent analyses and studies can be built and identifies performance characteristics the concept must exhibit in order to provide, at minimum, levels of safety and usage equal to or better than the current system.

Author

Failure; Materials Handling; Safety; Simulation; Systems Analysis; Systems Engineering; Air Transportation; Operational Problems

07
AIRCRAFT PROPULSION AND POWER

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

20030022772 North Carolina State Univ., Raleigh, NC, USA

Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events

Edwards, Jack R.; McRae, D. Scott; Bond, Ryan B.; Steffan, Christopher, Technical Monitor; March 2003; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG3?2658; NRA-TP-01-45; WU 708-87-23

Report No.(s): NASA/CR-2003-212193; E-13796; NAS 1.26:212193; No Copyright; Avail: CASI; A03, Hardcopy

The GTX program at NASA Glenn Research Center is designed to develop a launch vehicle concept based on rocket-based combined-cycle (RBCC) propulsion. Experimental testing, cycle analysis, and computational fluid dynamics modeling have all demonstrated the viability of the GTX concept, yet significant technical issues and challenges still remain. Our research effort develops a unique capability for dynamic CFD simulation of complete high-speed propulsion devices and focuses this technology toward analysis of the GTX response during critical mode transition events. Our principal attention is focused on Mode 1/Mode 2 operation, in which initial rocket propulsion is transitioned into thermal-throat ramjet propulsion. A critical element of the GTX concept is the use of an Independent Ramjet Stream (IRS) cycle to provide propulsion at Mach numbers less than 3. In the IRS cycle, rocket thrust is initially used for primary power, and the hot rocket plume is used as a flame-holding mechanism for hydrogen fuel injected into the secondary air stream. A critical aspect is the establishment of a thermal throat in the secondary stream through the combination of area reduction effects and combustion-induced heat release. This is a necessity to enable the power-down of the rocket and the eventual shift to ramjet mode. Our focus in this first year of the grant has been in three areas, each progressing directly toward the key initial goal of simulating thermal throat formation during the IRS cycle: CFD algorithm development; simulation of Mode 1 experiments conducted at Glenn's Rig 1 facility; and IRS cycle simulations. The remainder of this report discusses each of these efforts in detail and presents a plan of work for the next year.

Author

Computational Fluid Dynamics; Ramjet Engines; Rocket-Based Combined-Cycle Engines; Three Dimensional Models; Launch Vehicles; Test Facilities

20030031370 NASA Glenn Research Center, Cleveland, OH, USA

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center

Wey, Thomas; Liu, Nan-Suey; March 2003; 42 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 22-714-01-03

Report No.(s): NASA/TM-2003-212184; NAS 1.15:212184; E-13785; Copyright; Avail: CASI; A03, Hardcopy

The overall objective of the current effort at NASA GRC is to evaluate, develop, and apply methodologies suitable for modeling intra-engine trace chemical changes over post combustor flow path relevant to the pollutant emissions from aircraft engines. At the present time, the focus is the high pressure turbine environment. At first, the trace chemistry model of CNEWT were implemented into GLENN-HT as well as NCC. Then, CNEWT, CGLENN-HT, and NCC were applied to the trace species evolution in a cascade of Cambridge University's No. 2 rotor and in a turbine vane passage. In general, the results from these different codes provide similar features. However, the details of some of the quantities of interest can be sensitive to the differences of these codes. This report summaries the implementation effort and presents the comparison of the No. 2 rotor results obtained from these different codes. The comparison of the turbine vane passage results is reported elsewhere. In addition to the implementation of trace chemistry model into existing CFD codes, several pre/post-processing tools that can handle the manipulations of the geometry, the unstructured and structured grids as well as the CFD solutions also have been enhanced and seamlessly tied with NCC, CGLENN-HT, and CNEWT. Thus, a complete CFD package consisting of pre/post-processing tools and flow solvers suitable for post-combustor intra-engine trace chemistry study is assembled.

Author

Computational Fluid Dynamics; Computerized Simulation; Aircraft Engines; Combustion Chambers; Mathematical Models; Trace Contaminants; Exhaust Emission

20030032185 NASA Glenn Research Center, Cleveland, OH, USA

A Generalized Acoustic Analogy

Goldstein, M. E.; January 2003; 29 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The purpose of this article is to show that the Navier-Stokes equations can be rewritten as a set of linearized inhomogeneous Euler equations (in convective form) with source terms that are exactly the same as those that would result from externally imposed shear stress and energy flux perturbations. These results are used to develop a mathematical basis for some existing and potential new jet noise models by appropriately choosing the base flow about which the linearization is carried out.

Author

Jet Aircraft Noise; Linearization; Euler Equations Of Motion; Mathematical Models; Analogies

20030032190 NASA Kennedy Space Center, Cocoa Beach, FL, USA

Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector

Kandula, Max; Margasahayam, Ravi; Vu, Bruce; January 2003; 8 pp.; In English; 10th International Congress on Sound and Vibration, 7-10 Jul. 2003, Stockholm, Sweden

Report No.(s): KSC-2003-041; Copyright; Avail: CASI; A02, Hardcopy

An experimental study is performed on the acoustical characteristics of a scale-model, perfectly expanded, cold supersonic jet of gaseous nitrogen (Mach 2.5, nozzle exit diameter of 1 inch) flowing through a rigid-walled duct having an upstream J-deflector. The nozzle is mounted vertically, with the nozzle exit plane at a height of 73 jet diameters above ground level. Relative to the nozzle exit plane, the location of the duct inlet is varied at 10, 5, and -1 jet diameters. Far-field sound pressure levels were obtained at 2 levels (54 jet diameters and 10 jet diameters above ground) with the aid of 9 acoustic sensors equally spaced around a circular arc of radius equal to 80 jet diameters. Comparisons of the acoustic field were made with and without the duct.

Author

Sound Propagation; Supersonic Jet Flow; Ducts; Aeroacoustics

08
AIRCRAFT STABILITY AND CONTROL

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

20030022710 NASA Ames Research Center, Moffett Field, CA, USA

An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data

Huff, Edward M.; Mosher, Marianne; Barszcz, Eric; October 15, 2002; 14 pp.; In English; American Helicopter Society 2003, May 2003, Phoenix, AZ, USA

Contract(s)/Grant(s): RTOP 704-30-62; No Copyright; Avail: CASI; A03, Hardcopy

Recent research using NASA Ames AH-1 and OH-58C helicopters, and NASA Glenn test rigs, has shown that in-flight vibration data are typically non-stationary [l-4]. The nature and extent of this non-stationarity is most likely produced by several factors operating simultaneously. The aerodynamic flight environment and pilot commands provide continuously changing inputs, with a complex dynamic response that includes automatic feedback control from the engine regulator. It would appear that the combined effects operate primarily through an induced torque profile, which causes concomitant stress modulation at the individual internal gear meshes in the transmission. This notion is supported by several analyses, which show that upwards of 93\% of the vibration signal s variance can be explained by knowledge of torque alone. That this relationship is stronger in an AH-1 than an OH-58, where measured non-stationarity is greater, suggests that the overall mass of the vehicle is an important consideration. In the lighter aircraft, the unsteady aerodynamic influences transmit relatively greater unsteady dynamic forces on the mechanical components, quite possibly contributing to its greater non-stationarity . In a recent paper using OH-58C pinion data [5], the authors have shown that in computing a time synchronous average (TSA) for various single-value metric computations, an effective trade-off can be obtained between sample size and measured stationarity by using data from only a single mesh cycle. A mesh cycle, which is defined as the number of rotations required for the gear teeth to return to their original mating position, has the property of representing all of the discrete phase angles of the opposing gears exactly once in the average. Measured stationarity is probably maximized because a single mesh cycle of the pinion gear occurs over a very short span of time, during which time-dependent non-stationary effects are kept to a

minimum. Clearly, the advantage of local stationarity diminishes as the temporal duration of the cycle increases. This is most evident for a planetary mesh cycle, which can take several minutes to complete.
Author
Automatic Control; Time Dependence; Feedback Control; Dynamic Response; Helicopters; Vibration; Unsteady Aerodynamics

20030025283 Aquilent, Inc., Laurel, MD, USA
Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft
North, Steve; Hennessy, Joseph F., Technical Monitor; February 2003; 24 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The authors will report initial progress on the PIAudit project as a Research Resident Associate Program. The objective of this research is to prototype a tool for visualizing decision-making behaviours in autonomous spacecraft. This visualization will serve as an information source for human analysts. The current visualization prototype for PIAudit combines traditional Decision Trees with Weights of Evidence.
Author
Autonomy; Decision Making; Information Analysis

20030025292 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics
Bauer, Frank, Technical Monitor; Luquette, Richard J.; Sanner, Robert M.; [2003]; 9 pp.; In English; AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA
Report No.(s): AAS 03-007; Copyright; Avail: CASI; A02, Hardcopy

Precision Formation Flying is an enabling technology for a variety of proposed space-based observatories, including the Micro-Arcsecond X-ray Imaging Mission (MAXIM), the associated MAXIM pathfinder mission, and the Stellar Imager. An essential element of the technology is the control algorithm. This paper discusses the development of a nonlinear, six-degree of freedom (6DOF) control algorithm for maintaining the relative position and attitude of a spacecraft within a formation. The translation dynamics are based on the equations of motion for the restricted three body problem. The control law guarantees the tracking error convergences to zero, based on a Lyapunov analysis. The simulation, modelled after the MAXIM Pathfinder mission, maintains the relative position and attitude of a Follower spacecraft with respect to a Leader spacecraft, stationed near the L2 libration point in the Sun-Earth system.
Author
Algorithms; Formation Flying; Nonlinearity; Three Body Problem; Degrees Of Freedom; Spacecraft Control

20030025748 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Living with a Star Space Environment Testbed
Barth, Janet; January 2003; 5 pp.; In English; NATO Advanced Research Workshop on Effects of Space Weather on Tech. Infrastructure; No Copyright; Avail: CASI; A01, Hardcopy

Summary of activities: (1) FYO1 NRA - Model development and data mining. (2) FY03 NRA - Flight investigations. (3) SET carrier development. (4) Study for accommodation of SET carrier to support advanced detectors. (5) Collaboration with other programs: LWS TR&T to maximize synergy between TR&T space environment research and SET space environment effects research. LWS Data System to optimize dissemination of SET data. NASA Electronic Parts and Packaging Program to leverage ground testing of technologies. Defense Threat Reduction Agency to leverage ground testing and common interests in advanced detectors. and Air Force Research Laboratory to leverage flight opportunities. (6) Education and Public Outreach. Derived from text
Models; Environment Effects; Data Mining; Aerospace Environments

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)*.

20030025747 NASA Langley Research Center, Hampton, VA, USA
Recent Enhancements to the National Transonic Facility
Kilgore, W. A.; Balakrishna, S.; Bobbitt, C. W.; Underwood, P.; [2003]; 11 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-0754; No Copyright; Avail: CASI; A03, Hardcopy

The National Transonic Facility continues to make enhancements to provide quality data in a safe, efficient and cost effective method for aerodynamic ground testing. Recent enhancements discussed in this paper include the restoration of reliability and improved performance of the heat exchanger systems resulting in the expansion of the NTF air operations envelope. Additionally, results are presented from a continued effort to reduce model dynamics through the use of a new stiffer balance and sting.
Author
Test Facilities; Transonic Wind Tunnels; Aerodynamics; Wind Tunnel Tests

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*.

20030022705 NASA Glenn Research Center, Cleveland, OH, USA
High Voltage Space Solar Arrays
Ferguson, D. C.; Hillard, G. B.; Vayner, B. V.; Galofaro, J. T.; Lyons, Valerie, Technical Monitor; [2002]; 9 pp.; In English; 53rd International Astronautical Congress: The World space Congress-2002, 10-19 Oct. 2002, Houston, TX, USA; Original contains black and white illustrations
Report No.(s): IAC-02-IAA. 6.3.03; Copyright; Avail: CASI; A02, Hardcopy

Recent tests performed at the NASA Glenn Research Center and elsewhere have shown promise in the design and construction of high voltage (300-1000 V) solar arrays for space applications. Preliminary results and implications for solar array design will be discussed, with application to direct-drive electric propulsion and space solar power.
Author
High Voltages; Solar Arrays; Technology Utilization; Solar Electric Propulsion; Aerospace Systems

20030025378 NASA Goddard Space Flight Center, Greenbelt, MD, USA
GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite
Davis, George; Moreau, Michael; Carpenter, Russell; Bauer, Frank; [2002]; 11 pp.; In English; AIAA/AAS Astrodynamics Specialist Conference, 5-8 Aug. 2002, Monterey, CA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

The AMSAT OSCAR-40 (AO-40) spacecraft occupies a highly elliptical orbit (HEO) to support amateur radio experiments. An interesting aspect of the mission is the attempted use of GPS for navigation and attitude determination in HEO. Previous experiences with GPS tracking in such orbits have demonstrated the ability to acquire GPS signals, but very little data were produced for navigation and orbit determination studies. The AO-40 spacecraft, flying two Trimble Advanced Navigation Sensor (TANS) Vector GPS receivers for signal reception at apogee and at perigee, is the first to demonstrate autonomous tracking of GPS signals from within a HEO with no interaction from ground controllers. Moreover, over 11 weeks of total operations as of June 2002, the receiver has returned a continuous stream of code phase, Doppler, and carrier phase measurements useful for studying GPS signal characteristics and performing post-processed orbit determination studies in HEO. This paper presents the initial efforts to generate AO-40 navigation solutions from pseudorange data reconstructed from

the TANS Vector code phase, as well as to generate a precise orbit solution for the AO-40 spacecraft using a batch filter.
Author
Global Positioning System; Orbit Determination; Elliptical Orbits; Astronautics; Spacecraft Instruments; Navigation

20030025690 NASA Goddard Space Flight Center, Greenbelt, MD, USA
On-Orbit Testing of the EO-1 Pulsed Plasma Thruster
Zakrzwski, Charles; Benson, Scott; Sanneman, Paul; Hoskins, Andrew; [2002]; 11 pp.; In English; AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 7-10 Jul. 2002; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

The Pulsed Plasma Thruster (PPT) Experiment on the Earth Observing 1 (EO-1) spacecraft has demonstrated the capability of a new generation PPT to perform spacecraft attitude control. The PPT is a small, self-contained pulsed electromagnetic propulsion system capable of delivering high specific impulse (900-1200 s) and very small impulse bits (10-1000 microN-s) at low average power (4 to 100 W). EO-1 has a single PPT that can produce torque in the positive or negative pitch direction and replace the function of the spacecraft s pitch reaction wheel. The flight validation experiment was designed to demonstrate the ability of the PPT to provide precision pointing accuracy, response and stability, and to confirm that the thruster plume and EMI effects on the spacecraft and instruments were benign. The PPT has been successfully used for pitch attitude control accumulating over 26 hours of operational time with over 96,000 pulses. Thruster performance has been nominal and all spacecraft subsystems and instruments continue to show no detrimental effects from PPT operation.
Author
Pulsed Plasma Thrusters; Earth Observing System (Eos); Attitude Control; Electromagnetic Propulsion; Spaceborne Experiments

20030031373 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints
Berry, Matthew M.; Naasz, Bo J.; Kim, Hye-Young; Hall, Christopher D.; [2002]; 5 pp.; In English; Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, Puerto Rico; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy

HokieSat is a NASA Goddard sponsored spacecraft currently being built by students at Virginia Tech. HokieSat is part of the Ionospheric Observation Nanosatellite Formation (ION-F) project. The project involves spacecraft built by three schools: Virginia Tech (VT), Utah State University (USU), and University of Washington (UW). The three spacecraft are similar in design and will perform formation flying demonstrations, and make ionospheric measurements. HokieSat uses Pulsed Plasma Thrusters (PPTs) to maintain its position in the formation. There are two pairs of PPTs on HokieSat; their position on HokieSat's hexagonal cross-section is shown. Thrusters T(sub 2) and T(sub 3) provide translation control, and Thrusters TI and T4 can provide yaw steering. Any thruster can be fired individually. However because they share a capacitor, thrusters T(sub 1) and T(sub 2) or thrusters T(sub 3) and T(sub 4) cannot be fired simultaneously. Thrusters T(sub 2) T(sub 3) can be fired simultaneously, as well as thrusters T(sub 1) and T(sub 4). Each thruster provides an impulse-bit of 56 micronN-s and fires at a rate of 1 Hz. For translation control thrusters T2 and T3 are fired together providing an impulse-bit of 112 micronN-s. All four thrusters are positioned slightly above the center of mass, and therefore exert a torque on the spacecraft. Because there are no thrusters in the zenith-nadir directions, and the communication system requires that the spacecraft remain nadir-pointing, there is no way to thrust in the radial direction. The attitude of HokieSat is controlled by 3 orthogonal magnetic torque coils. Attitude control is achieved by forcing a current through the torque coils, which interacts with the Earth's magnetic field and creates a torque. Due to magnetic field interactions between the coils and PPTs, the two actuator systems cannot be used simultaneously, and any attitude or orbit control must be performed in a piecewise fashion. Power limitations place an additional constraint on the HokieSat control subsystem. When the spacecraft is in eclipse, the power subsystem can provide only enough power to operate vital spacecraft functions.
Author
Nanosatellites; Satellite Design; Formation Flying; Attitude Control; Satellite Control; Orbital Maneuvers

13
ASTRODYNAMICS

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

20030025298 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems
Xu, Yun-Jun; Fitz-Coy, Norman; Mason, Paul; [2003]; 4 pp.; In English; AAS G and C Conference, 5-9 Feb. 2003; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy

Formation flying systems can range from global constellations offering extended service coverage to clusters of highly coordinated vehicles that perform distributed sensing. Recently, the use of groups of micro-satellites in the areas of near Earth explorations, deep space explorations, and military applications has received considerable attention by researchers and practitioners. To date, most proposed control strategies are based on linear models (e.g., Hill-Clohessy-Wiltshire equations) or nonlinear models that are restricted to circular reference orbits. Also, all models in the literature are uncoupled between relative position and relative attitude. In this paper, a generalized dynamic model is proposed. The reference orbit is not restricted to the circular case. In this formulation, the leader or follower satellite can be in either a circular or an elliptic orbit. In addition to maintaining a specified relative position, the satellites are also required to maintain specified relative attitudes. Thus the model presented couples vehicle attitude and orbit requirements. Orbit perturbations are also included. In particular, the J(sub 2) effects are accounted in the model. Finally, a sliding mode controller is developed and used to control the relative attitude of the formation and the simulation results are presented.
Author
Formation Flying; Dynamic Control; Dynamic Models; Attitude (Inclination); Orbital Mechanics

20030025739 AI Solutions, Inc., USA
Flying a Four-Spacecraft Formation by the Moon...Twice
Guzman, Jose J.; Edery, Ariel; [2002]; 5 pp.; In English; 13th Annual AAS/AIAA Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, Puerto Rico; No Copyright; Avail: CASI; A01, Hardcopy

Spacecraft flying in tetrahedron formations are excellent for electromagnetic and plasma studies. To better understand the Earth s magnetosphere and its interaction with the solar wind, the NASA Goddard Magnetospheric Multiscale (MMS) mission will fly a tetrahedron formation through different regions of the magnetosphere close to the magnetic equatorial plane. However, to explore regions that are almost perpendicular to the ecliptic plane a dramatic plane change is needed. To minimize fuel, a double lunar swingby can be used to perform the plane change. This paper investigates the feasibility of flying a four-spacecraft formation through the required double lunar swingby.
Author
Earth Magnetosphere; Formation Flying; Trajectory Planning; Mission Planning; Orbit Determination; Spacecraft Trajectories; Swingby Technique

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)*.

20030025686 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Virtual Mission Operations Center - Collaborative Environment
Medina, Barbara; Bussman, Marie; January 2002; 10 pp.; In English; SpaceOps 2002, 9-12 Oct. 2002, Houston, TX, USA
Contract(s)/Grant(s): NASA Order S-43979-G; No Copyright; Avail: CASI; A02, Hardcopy

Development of technologies that enable significant reductions in the cost of space mission operations is critical if constellations, formations, federations and sensor webs, are to be economically feasible. One approach to cost reduction is to infuse automation technologies into mission operations centers so that fewer personnel are needed for mission support. But missions are more culturally and politically adverse to the risks of automation. Reducing the mission risk associated with increased use of automation within a MOC is therefore of great importance. The belief that mission risk increases as more automation is used stems from the fact that there is inherently less direct human oversight to investigate and resolve anomalies in an unattended MOC. The Virtual Missions Operations Center - Collaborative Environment (VMOC-CE) project was

launched to address this concern. The goal of the VMOC-CE project is to identify, develop, and infuse technology to enable mission operations between onsite operators and on-call personnel in geographically dispersed locations. VMOC-CE enables missions to more readily adopt automation because off-site operators and engineers can more easily identify, investigate, and resolve anomalies without having to be present in the MOC. The VMOC-CE intent is to have a single access point for all resources used in a collaborative mission operations environment. Team members will be able to interact during spacecraft operations, specifically for resolving anomalies, utilizing a desktop computer and the Internet. Mission operations management can use the VMOC-CE as a tool to participate in and monitor status of anomaly resolution or other mission operations issues. In this paper we present the VMOC-CE project, system capabilities and technologies, operations concept, and results of its pilot in support of the Earth Science Mission Operations System (ESMOS).
Author
Integrated Mission Control Center; Cost Reduction; Space Missions; Ground Based Control; Telecommunication; Problem Solving; Systems Engineering; Decision Support Systems

20030025730 NASA Marshall Space Flight Center, Huntsville, AL, USA
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design
Litchford, R. J.; Cole, J. W.; Lineberry, J. T.; Chapman, J. N.; Schmidt, H. J.; Lineberry, C. W.; February 2003; 42 pp.; In English; Original contains black and white illustrations
Report No.(s): NASA/TP-2003-212285; NAS 1.60:212285; M-1064; Copyright; Avail: CASI; A03, Hardcopy

The performance of conventional thermal propulsion systems is fundamentally constrained by the specific energy limitations associated with chemical fuels and the thermal limits of available materials. Electromagnetic thrust augmentation represents one intriguing possibility for improving the fuel composition of thermal propulsion systems, thereby increasing overall specific energy characteristics; however, realization of such a system requires an extremely high-energy-density electrical power source as well as an efficient plasma acceleration device. This Technical Publication describes the development of an experimental research facility for investigating the use of cross-field magnetohydrodynamic (MHD) accelerators as a possible thrust augmentation device for thermal propulsion systems. In this experiment,a 1.5-MW(sub e) Aerotherm arc heater is used to drive a 2-MW(sub e) MHD accelerator. The heatsink MHD accelerator is configured as an externally diagonalized, segmented channel, which is inserted into a large-bore, 2-T electromagnet. The performance analysis and engineering design of the flow path are described as well as the parameter measurements and flow diagnostics planned for the initial series of test runs.
Author
Thrust Augmentation; Magnetohydrodynamics; Electromagnetism; Propulsion System Performance; Plasma Acceleration; Research Facilities; Reliability Analysis

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*.

20030022661 NASA Glenn Research Center, Cleveland, OH, USA
High Altitude Launch for a Practical SSTO
Landis, Geoffrey A.; Denis, Vincent; Lyons, Valerie, Technical Monitor; February 2002; 6 pp.; In English; Conference on Next Generation Space Transportation, Space Technology and Applications Forum, 2-6 Feb. 2002, Albuquerque, NM, USA; Copyright; Avail: CASI; A02, Hardcopy

Existing engineering materials allow the construction of towers to heights of many kilometers. Orbital launch from a high altitude has significant advantages over sea-level launch due to the reduced atmospheric pressure, resulting in lower atmospheric drag on the vehicle and allowing higher rocket engine performance. High-altitude launch sites are particularly advantageous for single-stage to orbit (SSTO) vehicles, where the payload is typically 2\% of the initial launch mass. An earlier paper enumerated some of the advantages of high altitude launch of SSTO vehicles. In this paper, we calculate launch trajectories for a candidate SSTO vehicle, and calculate the advantage of launch at launch altitudes 5 to 25 kilometer altitudes above sea level. The performance increase can be directly translated into increased payload capability to orbit, ranging from 5 to 20\% increase in the mass to orbit. For a candidate vehicle with an initial payload fraction of 2\% of gross lift-off weight,

this corresponds to 31\% increase in payload (for 5-km launch altitude) to 122\% additional payload (for 25-km launch altitude).
Author
High Altitude; Towers; Spacecraft Launching; Materials Selection; Trajectory Analysis; Single Stage To Orbit Vehicles

16
SPACE TRANSPORTATION AND SAFETY

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

20030025347 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris
Lemoine, Frank G.; October 2002; 1 pp.; In English; Jason-1/TOPEX/Poseidon Science Working Team, 21-23 Oct. 2002, New Orleans, LA., USA; Copyright; Avail: Other Sources; Abstract Only

The GEOSAT Follow-On spacecraft (GFO-l), launched in 1998, began continuous radar altimeter coverage of the oceans in 2000, and after an extensive series of calibration campaigns in 1999 and 2000 was finally accepted by the US Navy on November 29, 2000. By providing high quality altimeter data, GFO can supplement TOPEX/POSEIDON(T/P), ERS-1, and ERS-2 data, providing a different synoptic sampling of the oceans with its 17-day ground track repeat cycle. Altimeter analysis suggests GFO is capable of POSEIDON class altimetry, with orbit error the largest contributor to the GFO altimeter error budget. Satellite laser ranging (SLR), especially in combination with altimeter crossover data, offer the only means of determining high-quality precise orbits. SLR tracking is also augmented by Doppler (Tranet style) beacons. These data were used to tune the gravity field and macromodel (3D representation of the spacecraft geometry and surface properties). Beginning with January 2000 GSFC has produced a 2.5 year span of the Precision Orbit Ephemeris (POE) intended for use on the GFO GDR and for the Pathfinder Project. Using GFO GDR and IGDR altimeter data from NOAA, a two year span of POE orbits are evaluated with respect to the TOPEX orbits by adjusting the GFO data into the TOPEX frame with the help of TOPEX/GFO altimeter crossovers. A 2.5 year span of orbits are also evaluated using tracking data residual analysis, GFO altimeter crossover residual analysis, and direct orbit comparison. In an effort to improve the current POE orbit several ideas are considered, including using recent gravity models which include CHAMP data, the reduced-dynamic approach, and including TOPEX/GFO altimeter crossover data in the orbit solution.
Author
Geosat Satellites; Satellite Tracking; Trajectory Analysis; Trajectory Planning; Satellite Laser Ranging; Orbit Determination

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*.

20030025224 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems
Kwadrat, Carl F.; Horne, William D.; Edwards, Bernard L.; [2002]; 10 pp.; In English; 2002 Space Operations Conference, 8-11 Oct. 2002, Houston, TX, USA; Copyright; Avail: CASI; A02, Hardcopy

In order to avoid selecting inadequate inter-spacecraft cross-link communications standards for Distributed Spacecraft System (DSS) missions, it is first necessary to identify cross-link communications strategies and requirements common to a cross-section of proposed missions. This paper addresses the cross-link communication strategies and requirements derived from a survey of 39 DSS mission descriptions that are projected for potential launch within the next 20 years. The inter-spacecraft communications strategies presented are derived from the topological and communications constraints from the DSS missions surveyed. Basic functional requirements are derived from an analysis of the fundamental activities that must be undertaken to establish and maintain a cross-link between two DSS spacecraft. Cross-link bandwidth requirements are derived from high-level assessments of mission science objectives and operations concepts. Finally, a preliminary assessment

of possible cross-link standards is presented within the context of the basic operational and interoperability requirements. Author

Satellite Communication; Space Missions; Systems Engineering; Interoperability; Formation Flying; Crosslinking; Satellite Constellations

20030025278 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network

Rakow, Glenn; Schnurr, Richard; Dailey, Christopher; Shakoorzadeh, Kamdin; [2003]; 14 pp.; In English; 2003 IEEE Aerospace Conference, 8-15 Mar. 2003, Big Sky, MT, USA; Original contains black and white illustrations

Report No.(s): IEEEAC Paper 1264; Copyright; Avail: CASI; A03, Hardcopy

NASA's James Webb Space Telescope (JWST) faces difficult technical and budgetary challenges to overcome before it is scheduled launch in 2010. The Integrated Science Instrument Module (ISIM), shares these challenges. The major challenge addressed in this paper is the data network used to collect, process, compresses and store Infrared data. A total of 114 Mbps of raw information must be collected from 19 sources and delivered to the two redundant data processing units across a twenty meter deployed thermally restricted interface. Further data must be transferred to the solid-state recorder and the spacecraft. The JWST detectors are kept at cryogenic temperatures to obtain the sensitivity necessary to measure faint energy sources. The Focal Plane Electronics (FPE) that sample the detector, generate packets from the samples, and transmit these packets to the processing electronics must dissipate little power in order to help keep the detectors at these cold temperatures. Separating the low powered front-end electronics from the higher-powered processing electronics, and using a simple high-speed protocol to transmit the detector data minimize the power dissipation near the detectors. Low Voltage Differential Signaling (LVDS) drivers were considered an obvious choice for physical layer because of their high speed and low power. The mechanical restriction on the number cables across the thermal interface force the Image packets to be concentrated upon two high-speed links. These links connect the many image packet sources, Focal Plane Electronics (FPE), located near the cryogenic detectors to the processing electronics on the spacecraft structure. From 12 to 10,000 seconds of raw data are processed to make up an image, various algorithms integrate the pixel data Loss of commands to configure the detectors as well as the loss of science data itself may cause inefficiency in the use of the telescope that are unacceptable given the high cost of the observatory. This combination of requirements necessitates a redundant, fault tolerant, high- speed, low mass, low power network with a low Bit error Rate(1E-9- 1E-12). The ISIM systems team performed many studies of the various network architectures that meeting these requirements. The architecture selected uses the Spacewire protocol, with the addition of a new transport and network layer added to implement end-to-end reliable transport. The network and reliable transport mechanism must be implemented in hardware because of the high average information rate and the restriction on the ability of the detectors to buffer data due to power and size restrictions. This network and transport mechanism was designed to be compatible with existing Spacewire links and routers so that existing equipment and designs may be leveraged upon. The transport layer specification is being coordinated with European Space Agency (ESA), Spacewire Working Group and the Consultative Committee for Space Data System (CCSDS) PlK Standard Onboard Interface (SOIF) panel, with the intent of developing a standard for reliable transport for Spacewire. Changes to the protocol presented are likely since negotiations are ongoing with these groups. A block of RTL VHDL that implements a multi-port Spacewire router with an external user interface will be developed and integrated with an existing Spacewire Link design. The external user interface will be the local interface that sources and sinks packets onto and off of the network (Figure 3). The external user interface implements the network and transport layer and handles acknowledgements and re-tries of packets for reliable transport over the network. Because the design is written in RTL, it may be ported to any technology but will initially be targeted to the new Actel Accelerator series (AX) part. Each link will run at 160 Mbps and the power will be about 0.165 Watt per link worst case in the Actel AX.

Author

Spaceborne Telescopes; Instrument Packages; Communication Networks; Data Transmission; Data Processing Equipment

20030025332 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Multiple Autonomous Discrete Event Controllers for Constellations

Esposito, Timothy C.; [2003]; 6 pp.; In English; 2003 IEEE Aerospace Conference, 8-15 Mar. 2003, Big Sky, MT, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The Multiple Autonomous Discrete Event Controllers for Constellations (MADECC) project is an effort within the National Aeronautics and Space Administration Goddard Space Flight Center's (NASA/GSFC) Information Systems Division to develop autonomous positioning and attitude control for constellation satellites. It will be accomplished using traditional control theory and advanced coordination algorithms developed by the Johns Hopkins University Applied Physics Laboratory (JHU/APL). This capability will be demonstrated in the discrete event control test-bed located at JHU/APL. This project will

be modeled for the Leonardo constellation mission, but is intended to be adaptable to any constellation mission. To develop a common software architecture. the controllers will only model very high-level responses. For instance, after determining that a maneuver must be made. the MADECC system will output B (Delta)V (velocity change) value. Lower level systems must then decide which thrusters to fire and for how long to achieve that (Delta)V.
Author
Attitude Control; Automatic Control; Autonomy; Information Systems

20030025352 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Internet Technology for Future Space Missions
Hennessy, Joseph F., Technical Monitor; Rash, James; Casasanta, Ralph; Hogie, Keith; October 2002; 9 pp.; In English; International Telemetering Conference 2002, 21-24 Oct. 2002, San Diego, CA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): GS-35F-4381G; S-43981-G; Copyright; Avail: CASI; A02, Hardcopy

Ongoing work at National Aeronautics and Space Administration Goddard Space Flight Center (NASA/GSFC), seeks to apply standard Internet applications and protocols to meet the technology challenge of future satellite missions. Internet protocols and technologies are under study as a future means to provide seamless dynamic communication among heterogeneous instruments, spacecraft, ground stations, constellations of spacecraft, and science investigators. The primary objective is to design and demonstrate in the laboratory the automated end-to-end transport of files in a simulated dynamic space environment using off-the-shelf, low-cost, commodity-level standard applications and protocols. The demonstrated functions and capabilities will become increasingly significant in the years to come as both earth and space science missions fly more sensors and the present labor-intensive, mission-specific techniques for processing and routing data become prohibitively. This paper describes how an IP-based communication architecture can support all existing operations concepts and how it will enable some new and complex communication and science concepts. The authors identify specific end-to-end data flows from the instruments to the control centers and scientists, and then describe how each data flow can be supported using standard Internet protocols and applications. The scenarios include normal data downlink and command uplink as well as recovery scenarios for both onboard and ground failures. The scenarios are based on an Earth orbiting spacecraft with downlink data rates from 300 Kbps to 4 Mbps. Included examples are based on designs currently being investigated for potential use by the Global Precipitation Measurement (GPM) mission.
Author
Internets; Protocol (Computers); Space Missions; Space Communication; Applications Programs (Computers)

20030025363 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset
Luthcke, Scott B.; October 2002; 1 pp.; In English; Jason-1/TOPEX/Poseidon Science Working Team, 21-23 Oct. 2002, New Orleans, LA, USA; No Copyright; Avail: Other Sources; Abstract Only

Jason-1, launched on December 7, 2001, is continuing the time series of centimeter level Ocean topography observations as the follow-on to the highly successful TOPEX/POSEIDON (T/P) radar altimeter satellite. The precision orbit determination (POD) is a critical component to meeting the Ocean topography goals of the mission. T/P has demonstrated that the time variation of Ocean topography can be determined with an accuracy of a few centimeters, thanks to the availability of highly accurate orbits based primarily on SLR+DORIS tracking. The Jason-1 mission is intended to continue measurement of the Ocean surface with the same, if not better accuracy.
Author
Calibrating; Global Positioning System; Orbit Determination; Tracking (Position)

20030025663 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Satellite GN and C Anomaly Trends
Robertson, Brent; Stoneking, Eric; [2003]; 15 pp.; In English; 2003 AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA
Report No.(s): AAS-03-071; No Copyright; Avail: CASI; A03, Hardcopy

On-orbit anomaly records for satellites launched from 1990 through 2001 are reviewed to determine recent trends of un-manned space mission critical failures. Anomalies categorized by subsystems show that Guidance, Navigation and Control (GN&C) subsystems have a high number of anomalies that result in a mission critical failure when compared to other

subsystems. A mission critical failure is defined as a premature loss of a satellite or loss of its ability to perform its primary mission during its design life. The majority of anomalies are shown to occur early in the mission, usually within one year from launch. GN&C anomalies are categorized by cause and equipment type involved. A statistical analysis of the data is presented for all anomalies compared with the GN&C anomalies for various mission types, orbits and time periods. Conclusions and recommendations are presented for improving mission success and reliability.
Author
Unmanned Spacecraft; Satellite Guidance; Trend Analysis; Anomalies; Data Reduction

20030025700 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS
Conley, Carolynn Lee; Bauer, Frank H.; Brown, Deborah A.; White, Rosalie, Americ; January 2002; 9 pp.; In English; World Space Congress, 10-19 Oct. 2002, Houston, TX, USA; Original contains color illustrations
Report No.(s): IAC-02-P.3.02; Copyright; Avail: CASI; A02, Hardcopy

Amateur Radio on the International Space Station (ARISS) represents the first educational outreach program that is flying on the International Space Station (ISS). The astronauts and cosmonauts will work hard on the International Space Station, but they plan to take some time off for educational activities with schools. The National Aeronautics and Space Administration s (NASA s) Education Division is a major supporter and sponsor of this student outreach activity on the ISS. This meets NASA s educational mission objective: To inspire the next generation of explorers.. .as only NASA can. The amateur radio community is helping to enrich the experience of those visiting and living on the station as well as the students on Earth. Through ARISS sponsored hardware and activities, students on Earth get a first-hand feel of what it is like to live and work in space. This paper will discuss the educational outreach accomplishments of ARISS, the school contact process, the ARISS international cooperation and volunteers, and ISS Ham radio plans for the future.
Author
Education; NASA Programs; Students; International Space Station; Schools

20030025773 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Amateur Radio on the International Space Station: The First Operational Payload on the ISS
Bauer, Frank H.; McFadin, Lou; Steiner, Mark D.; Conley, Carolynn L.; September 30, 2002; 11 pp.; In English; World Space Congress, 10-19 Oct. 2002, Houston, TX, USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy

As astronauts and cosmonauts have adapted to life on the International Space Station (ISS), they have found amateur radio and its connection to life on Earth to be a important on-board companion and a substantial psychological boost. Since its first use in November 2000, the first five expedition crews have utilized the amateur radio station in the Functional Cargo Block (also referred to as the FGB or Zarya module) to talk to thousands of students in schools, to their families on Earth, and to amateur radio operators around the world. This paper will discuss the development, qualification, installation and operation of the amateur radio system. It will also discuss some of the challenges that the amateur radio international team of volunteers overcame to bring its first phase of equipment on ISS to fruition.
Author
International Space Station; Radio Communication; Radio Equipment; Spacecrews

20030032239 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Navigation Guidelines for Orbital Formation Flying Missions
Carpenter, J. Russell; [2003]; 1 pp.; In English; AIAA GNC Conference, 11-14 Aug. 2003, Austin, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

Some simple guidelines based on the accuracy in determining a satellite formation's semi-major axis differences are useful in making preliminary assessments of the navigation accuracy needed to support such missions. These guidelines are valid for any elliptical orbit, regardless of eccentricity. Although maneuvers required for formation establishment, reconfiguration, and station-keeping require accurate prediction of the state estimate to the maneuver time, and hence are directly affected by errors in all the orbital elements, experience has shown that determination of orbit plane orientation and orbit shape to acceptable levels is less challenging than the determination of orbital period or semi-major axis. Furthermore, any differences among the member's semi-major axis are undesirable for a satellite formation, since it will lead to differential along-track drift due to period differences. Since inevitable navigation errors prevent these differences from ever being zero, one may use the guidelines this paper presents to determine how much drift will result from a given relative navigation accuracy, or vice versa. Since the guidelines do not account for non-two-body perturbations, they may be viewed as useful

preliminary design tools, rather than as the basis for mission navigation requirements, which should be based on detailed analysis of the mission configuration, including all relevant sources of uncertainty.
Author
Formation Flying; Navigation; Space Missions; Orbital Mechanics

20030032254 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Relative Navigation of Formation-Flying Satellites
Long, Anne; Kelbel, David; Lee, Taesul; Leung, Dominic; Carpenter, J. Russell; Grambling, Cheryl; [2002]; 8 pp.; In English; International Symposium on Formation Flying Mission and Technology, 29-31 Oct. 2002, Toulouse, France; Original contains color illustrations; Copyright; Avail: CASI; A02, Hardcopy

This paper compares autonomous relative navigation performance for formations in eccentric, medium and high-altitude Earth orbits using Global Positioning System (GPS) Standard Positioning Service (SPS), crosslink, and celestial object measurements. For close formations, the relative navigation accuracy is highly dependent on the magnitude of the uncorrelated measurement errors. A relative navigation position accuracy of better than 10 centimeters root-mean-square (RMS) can be achieved for medium-altitude formations that can continuously track at least one GPS signal. A relative navigation position accuracy of better than 15 meters RMS can be achieved for high-altitude formations that have sparse tracking of the GPS signals. The addition of crosslink measurements can significantly improve relative navigation accuracy for formations that use sparse GPS tracking or celestial object measurements for absolute navigation.
Author
Autonomous Navigation; Global Positioning System; Formation Flying; Position Errors

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*.

20030020924 NASA Glenn Research Center, Cleveland, OH, USA
LEO Spacecraft Charging Guidelines
Hillard, G. B.; Ferguson, D. C.; [2002]; 5 pp.; In English; 53rd International Astronautical Conference, 10 - 19 Oct. 2002, Houston, TX., USA
Contract(s)/Grant(s): RTOP 755-A4-05
Report No.(s): IAC-02-IAA. 6.3.02; E-13686; Copyright; Avail: CASI; A01, Hardcopy

Over the past decade, Low Earth Orbiting (LEO) spacecraft have gradually required ever-increasing power levels. As a rule, this has been accomplished through the use of high voltage systems. Recent failures and anomalies on such spacecraft have been traced to various design practices and materials choices related to the high voltage solar arrays. NASA Glenn has studied these anomalies including plasma chamber testing on arrays similar to those that experienced difficulties on orbit. Many others in the community have been involved in a comprehensive effort to understand the problems and to develop practices to avoid them. The NASA Space Environments and Effects program, recognizing the timeliness of this effort, has commissioned and funded a design guidelines document intended to capture the current state of understanding. We present here an overview of this document, which is now nearing completion.
Author
Spacecraft Charging; Solar Arrays; Spacecraft Power Supplies; Design Analysis; Materials Selection; Failure Analysis; Anomalies

20030022681 Lockheed Martin Missiles and Space, Denver, CO, USA
Onboard Processor for Compressing HSI Data
Cook, Sid; Harsanyi, Joe; Day, John H., Technical Monitor; September 2002; 5 pp.; In English; IEEE-AIPR 2002, 16-18 Oct. 2002, Washington, DC, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS5-00216; Copyright; Avail: CASI; A01, Hardcopy

With EO-1 Hyperion and MightySat in orbit NASA and the DoD are showing their continued commitment to hyperspectral imaging (HSI). As HSI sensor technology continues to mature, the ever-increasing amounts of sensor data

generated will result in a need for more cost effective communication and data handling systems. Lockheed Martin, with considerable experience in spacecraft design and developing special purpose onboard processors, has teamed with Applied Signal & Image Technology (ASIT), who has an extensive heritage in HSI, to develop a real-time and intelligent onboard processing (OBP) system to reduce HSI sensor downlink requirements. Our goal is to reduce the downlink requirement by a factor greater than 100, while retaining the necessary spectral fidelity of the sensor data needed to satisfy the many science, military, and intelligence goals of these systems. Our initial spectral compression experiments leverage commercial-off-the-shelf (COTS) spectral exploitation algorithms for segmentation, material identification and spectral compression that ASIT has developed. ASIT will also support the modification and integration of this COTS software into the OBP. Other commercially available COTS software for spatial compression will also be employed as part of the overall compression processing sequence. Over the next year elements of a high-performance reconfigurable OBP will be developed to implement proven preprocessing steps that distill the HSI data stream in both spectral and spatial dimensions. The system will intelligently reduce the volume of data that must be stored, transmitted to the ground, and processed while minimizing the loss of information.
Author

Airborne/Spaceborne Computers; Onboard Data Processing; Data Compression; Spectrum Analysis; Data Flow Analysis; Applications Programs (Computers); Spacecraft Design

20030022728 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology

LaBel, Kenneth A.; Barth, Janet L.; Brewer, Dana A.; [2003]; 17 pp.; In English; 2003 Hardened Electronics and Radiation Technology (HEART) Conference, 10-14 Mar. 2003, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides information on flight validation experiments for technologies to determine solar effects. The experiments are intended to demonstrate tolerance to a solar variant environment. The technologies tested are microelectronics, photonics, materials, and sensors.
CASI

Aerospace Environments; Solar Activity Effects; Test Stands; Microelectronics; Photonics; Exposure

20030022762 NASA, Washington, DC, USA

Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua

Kenny, Thomas; Lee, Albert; Donnelly, Michael; Schroder, Michael; McNally, Mark; [2003]; 14 pp.; In English; 2003 AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

The TRW built EOS Aqua spacecraft uses two Ball Aerospace CT-602 star trackers to provide attitude updates to the 3-axis, zero momentum, controller. Two months prior to the scheduled launch of Aqua, Ball reported an error in the design of the star tracker lightshades. The lightshades, which had been designed specifically for the EOS Common spacecraft, were not expected to meet the stray light rejection requirements of the mission, thus impacting the overall spacecraft pointing performance. What ensued was an effort to characterize the actual performance of the existing shade design, determine what could be done within the physical envelope available, and modify the hardware to meet requirements. Changes were made based on this review activity and Aqua was launched on May 4, 2002. To date the spacecraft is meeting all of its science pointing requirements. Reported here are the lightshade design predictions, test results, and the measured on orbit performance of these shades.
Author

Star Trackers; Earth Observing System (Eos); Shades; Light (Visible Radiation); Structural Design; Spacecraft Performance

20030022777 NASA Goddard Space Flight Center, Greenbelt, MD, USA

NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1)

Folta, David; Bristow, John; Hawkins, Albin; Dell, Greg; [2002]; 8 pp.; In English; International Symposium: Formation Flying Mlssions and Technology, 29-31 Oct. 2002, Toulouse, France; Copyright; Avail: CASI; A02, Hardcopy

NASA's first autonomous formation flying mission, the New Millennium Program's (NMP) Earth Observing-1 (EO-1) spacecraft, recently completed its principal goal of demonstrating advanced formation control technology. This paper provides an overview of the evolution of an onboard system that was developed originally as a ground mission planning and operations tool. We discuss the Goddard Space Flight Center s formation flying algorithm, the onboard flight design and its implementation, the interface and functionality of the onboard system, and the implementation of a Kalman filter based GPS

data smoother. A number of safeguards that allow the incremental phasing in of autonomy and alleviate the potential for mission-impacting anomalies from the on- board autonomous system are discussed. A comparison of the maneuvers planned onboard using the EO-1 autonomous control system to those from the operational ground-based maneuver planning system is presented to quantify our success. The maneuvers discussed encompass reactionary and routine formation maintenance. Definitive orbital data is presented that verifies all formation flying requirements.
Author
Formation Flying; Autonomy; Spacecraft Control

20030025243 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission
Li, K. E.; Xapsos, M. A.; Poivey, C.; LaBel, K. A.; Stone, R. F.; Yeh, P-S.; Gambles, J.; Hass, J.; Maki, G.; Marguia, J.; [2003]; 10 pp.; In English; Hardened Electronics and Radiation Technology (HEART) Conference, 10-13 Mar. 2003, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

This viewgraph presentation provides information on radiation tests on encoders intended for a constellation of microsatellites. The encoders use CMOS Ultra-Low Power Radiation Tolerant (CULPRiT) technology. The presentation addresses power consumption, radiation dosage, and Single Event Upset (SEU).
CASI
Microsatellites; Coders; Microelectronics; Radiation Dosage; Energy Consumption

20030025265 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods
Bauer, Frank, Technical Monitor; Folta, David; Beckman, Mark; [2002]; 17 pp.; In English; International Conference on Libration Point Orbits and Applications, 10-14 Jun. 2002, Girona, Spain; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Sun-Earth libration point orbits serve as excellent locations for scientific investigations. These orbits are often selected to minimize environmental disturbances and maximize observing efficiency. Trajectory design in support of libration orbits is ever more challenging as more complex missions are envisioned in the next decade. Trajectory design software must be further enabled to incorporate better understanding of the libration orbit solution space and thus improve the efficiency and expand the capabilities of current approaches. The Goddard Space Flight Center (GSFC) is currently supporting multiple libration missions. This end-to-end support consists of mission operations, trajectory design, and control. It also includes algorithm and software development. The recently launched Microwave Anisotropy Probe (MAP) and upcoming James Webb Space Telescope (JWST) and Constellation-X missions are examples of the use of improved numerical methods for attaining constrained orbital parameters and controlling their dynamical evolution at the collinear libration points. This paper presents a history of libration point missions, a brief description of the numerical and dynamical design techniques including software used, and a sample of future GSFC mission designs.
Author
Earth Orbits; Microwave Anisotropy Probe; Numerical Analysis; Trajectory Control

20030025267 NASA Goddard Space Flight Center, Greenbelt, MD, USA
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying
Gill, E.; Naasz, Bo; Ebinuma, T.; [2003]; 2 pp.; In English; 26th Annual AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA; Copyright; Avail: CASI; A01, Hardcopy

A closed-loop system for the demonstration of formation flying technologies has been developed at NASA s Goddard Space Flight Center. Making use of a GPS signal simulator with a dual radio frequency outlet, the system includes two GPS space receivers as well as a powerful onboard navigation processor dedicated to the GPS-based guidance, navigation, and control of a satellite formation in real-time. The closed-loop system allows realistic simulations of autonomous formation flying scenarios, enabling research in the fields of tracking and orbit control strategies for a wide range of applications. A sample scenario has been set up where the autonomous transition of a satellite formation from an initial along-track separation of 800 m to a final distance of 100 m has been demonstrated. As a result, a typical control accuracy of about 5 m has been achieved which proves the applicability of autonomous formation flying techniques to formations of satellites as close as 50 m.
Author
Autonomy; Feedback Control; Formation Flying; Hardware-In-The-Loop Simulation; Systems Engineering; Satellite Design

20030025285 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Orbit Determination Support for the Microwave Anisotropy Probe (MAP)

Bauer, Frank, Technical Monitor; Truong, Son H.; Cuevas, Osvaldo O.; Slojkowski, Steven; January 2003; 15 pp.; In English; 13th Annual AAS/AIAA Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, Puerto Rico; No Copyright; Avail: CASI; A03, Hardcopy

NASA's Microwave Anisotropy Probe (MAP) was launched from the Cape Canaveral Air Force Station Complex 17 aboard a Delta II 7425-10 expendable launch vehicle on June 30, 2001. The spacecraft received a nominal direct insertion by the Delta expendable launch vehicle into a 185-km circular orbit with a 28.7deg inclination. MAP was then maneuvered into a sequence of phasing loops designed to set up a lunar swingby (gravity-assisted acceleration) of the spacecraft onto a transfer trajectory to a lissajous orbit about the Earth-Sun L2 Lagrange point, about 1.5 million km from Earth. Because of its complex orbital characteristics, the mission provided a unique challenge for orbit determination (OD) support in many orbital regimes. This paper summarizes the premission trajectory covariance error analysis, as well as actual OD results. The use and impact of the various tracking stations, systems, and measurements will be also discussed. Important lessons learned from the MAP OD support team will be presented. There will be a discussion of the challenges presented to OD support including the effects of delta-Vs at apogee as well as perigee, and the impact of the spacecraft attitude mode on the OD accuracy and covariance analysis.

Author

Microwave Anisotropy Probe; Orbit Determination; Circular Orbits; Delta Launch Vehicle; Error Analysis

20030025293 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Flight Testing of the Capillary Pumped Loop 3 Experiment

Ottenstein, Laura; Butler, Dan; Ku, Jentung; Cheung, Kwok; Baldauff, Robert; Hoang, Triem; [2002]; 10 pp.; In English; Space Technology and Applications Forum, 2-6 Feb. 2003, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

The Capillary Pumped Loop 3 (CAPL 3) experiment was a multiple evaporator capillary pumped loop experiment that flew in the Space Shuttle payload bay in December 2001 (STS-108). The main objective of CAPL 3 was to demonstrate in micro-gravity a multiple evaporator capillary pumped loop system, capable of reliable start-up, reliable continuous operation, and heat load sharing, with hardware for a deployable radiator. Tests performed on orbit included start-ups, power cycles, low power tests (100 W total), high power tests (up to 1447 W total), heat load sharing, variable/fixed conductance transition tests, and saturation temperature change tests. The majority of the tests were completed successfully, although the experiment did exhibit an unexpected sensitivity to shuttle maneuvers. This paper describes the experiment, the tests performed during the mission, and the test results.

Author

Flight Tests; Evaporators; Capillary Tubes; Spaceborne Experiments; Pumps; Systems Engineering

20030025662 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller

Maghami, P. G.; Markley, F. L.; Houghton, M. B.; Dennehy, C. J.; January 02, 2003; 7 pp.; In English; 26th Annual AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA

Report No.(s): AAS-03-065; No Copyright; Avail: CASI; A02, Hardcopy

The Space Technology 7 experiment will perform an on-orbit system-level validation of two specific Disturbance Reduction System technologies: a gravitational reference sensor employing a free-floating test mass and a set of micronewton colloidal thrusters. The Disturbance Reduction System is designed to maintain a spacecraft's position with respect to the free-floating test mass to less than 10 nm/square root of Hz, over the frequency range 10(exp -3) Hz to 10(exp -2) Hz. This paper presents the design and analysis of the coupled drag-free and attitude control system that closes the loop between the gravitational reference sensor and the micronewton thrusters while incorporating star tracker data at low frequencies. The effects of actuation and measurement noise and disturbances on the spacecraft and test masses are evaluated in a seven-degree-of-freedom planar model incorporating two translational and one rotational degrees of freedom for the spacecraft and two translational degrees of freedom for each test mass.

Author

Space Technology Experiments; Design Analysis; Controllers; Spacecraft Control; Attitude Control; Control Systems Design

20030025665 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Formation Flying Design and Applications in Weak Stability Boundary Regions

Folta, David; [2003]; 1 pp.; In English; New Trends in Astrodynamics and Applications, January 20-23, 2003, College Park, MD, USA; No Copyright; Avail: Other Sources; Abstract Only

Weak Stability regions serve as superior locations for interferometric scientific investigations. These regions are often selected to minimize environmental disturbances and maximize observing efficiency. Design of formations in these regions are becoming ever more challenging as more complex missions are envisioned. The development of algorithms to enable the capability for formation design must be further enabled to incorporate better understanding of WSB solution space. This development will improve the efficiency and expand the capabilities of current approaches. The Goddard Space Flight Center (GSFC) is currently supporting multiple formation missions in WSB regions. This end-to-end support consists of mission operations, trajectory design, and control. It also includes both algorithm and software development. The Constellation-X, Maxim, and Stellar Imager missions are examples of the use of improved numerical methods for attaining constrained formation geometries and controlling their dynamical evolution. This paper presents a survey of formation missions in the WSB regions and a brief description of the formation design using numerical and dynamical techniques.

Author

Formation Flying; Spacecraft Control; Spacecraft Guidance; Space Navigation; Trajectory Planning

20030025683 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Large Coded Aperture Mask for Spaceflight Hard X-ray Images

Vigneau, Danielle N.; Robinson, David W.; [2002]; 10 pp.; In English; The International Society for Optical Engineering Conference, 22-28 Aug. 2002, Hawaii, USA Minor Outlying Islands; No Copyright; Avail: CASI; A02, Hardcopy

The 2.6 square meter coded aperture mask is a vital part of the Burst Alert Telescope on the Swift mission. A random, but known pattern of more than 50,000 lead tiles, each 5 mm square, was bonded to a large honeycomb panel which projects a shadow on the detector array during a gamma ray burst. A two-year development process was necessary to explore ideas, apply techniques, and finalize procedures to meet the strict requirements for the coded aperture mask. Challenges included finding a honeycomb substrate with minimal gamma ray attenuation, selecting an adhesive with adequate bond strength to hold the tiles in place but soft enough to allow the tiles to expand and contract without distorting the panel under large temperature gradients, and eliminating excess adhesive from all untiled areas. The largest challenge was to find an efficient way to bond the > 50,000 lead tiles to the panel with positional tolerances measured in microns. In order to generate the desired bondline, adhesive was applied and allowed to cure to each tile. The pre-cured tiles were located in a tool to maintain positional accuracy, wet adhesive was applied to the panel, and it was lowered to the tile surface with synchronized actuators. Using this procedure, the entire tile pattern was transferred to the large honeycomb panel in a single bond. The pressure for the bond was achieved by enclosing the entire system in a vacuum bag. Thermal vacuum and acoustic tests validated this approach. This paper discusses the methods, materials, and techniques used to fabricate this very large and unique coded aperture mask for the Swift mission.

Author

Masks; Apertures; X Ray Imagery; Space Flight; Honeycomb Structures

20030025732 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Satellite Servicing in Mission Design Studies at the NASA GSFC

Leete, Stephen J.; January 2, 2003; 10 pp.; In English; IEEE 2003 Aerospace Conference, 8-15 Mar. 2003, Big Sky, MT, USA; No Copyright; Avail: CASI; A02, Hardcopy

Several NASA missions in various stages of development have undergone one-week studies in the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Integrated Mission Design Center (IMDC), mostly in preparation for proposals. The possible role of satellite servicing has been investigated for several of these missions, applying the lessons learned from Hubble Space Telescope (HST) servicing, taking into account the current state of the art, projecting into the future, and implementing NASA long-range plans, and is presented here. The general benefits and costs of injecting satellite servicing are detailed, including components such as mission timeline, mass, fuel, spacecraft design, risk abatement, life extension, and improved performance. The approach taken in addressing satellite servicing during IMDC studies is presented.

Author

Mission Planning; NASA Programs; Spacecraft Maintenance; Artificial Satellites

20030025749 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Models Required to Mitigate Impacts of Space Weather on Space Systems

Barth, Janet L.; [2003]; 16 pp.; In English; NATO Advanced Research Workshop on Effects of Space Weather on Tech. Infrastructure; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation attempts to develop a model of factors which need to be considered in the design and construction of spacecraft to lessen the effects of space weather on these vehicles. Topics considered include: space environments and effects, radiation environments and effects, space weather drivers, space weather models, climate models, solar proton activity and mission design for the GOES mission. The authors conclude that space environment models need to address issues from mission planning through operations and a program to develop and validate authoritative space environment models for application to spacecraft design does not exist at this time.

Author

Aerospace Environments; Aerospace Systems; Spacecraft Design; Space Weather; Atmospheric Models; Environment Models; Radiation Effects; Fatigue (Materials)

20030025765 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Radiation Requirements and Requirements Flowdown: Single Event Effects (SEEs) and Requirements

LaBel, Kenneth A.; [2002]; 53 pp.; In English; Hardened Electronics and Radiation Technology Short Course, 12 Mar. 2003; Original contains black and white illustrations; No Copyright; Avail: CASI; A04, Hardcopy

This short course session provides: (1) an overview of the single particle-induced hazard for space system as they apply in the natural space environment. This shall focus on the implementation of a single event effect hardness assurance (SEEHA) program for systems including system engineering approach and mitigation of effects. (2) The final portion of this session shell provide relevant real-life examples of in-flight performance of systems.

Author

Hazards; Single Event Upsets; Particles

20030025775 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Controlling Variable Emittance (MEMS) Coatings for Space Applications

Farrar, D.; Schneider, W.; Osiander, R.; Champion, J. L.; Darrin, A. G.; Douglas, Donya; Swanson, Ted D.; [2003]; 7 pp.; In English; STAIF-2003, 2-5 Feb. 2003; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Small spacecraft, including micro and nanosats, as they are envisioned for future missions, will require an alternative means to achieve thermal control due to their small power and mass budgets. One of the proposed alternatives is Variable Emittance (Vari-E) Coatings for spacecraft radiators. Space Technology-5 (ST-5) is a technology demonstration mission through NASA Goddard Space Flight Center (GSFC) that will utilize Vari-E Coatings. This mission involves a constellation of three (3) satellites in a highly elliptical orbit with a perigee altitude of approximately 200 kilometers and an apogee of approximately 38,000 kilometers. Such an environment will expose the spacecraft to a wide swing in the thermal and radiation environment of the earth's atmosphere. There are three (3) different technologies associated with this mission. The three technologies are electrophoretic, electrochromic, and Micro ElectroMechanical Systems (MEMS). The ultimate goal is to make use of Van-E coatings, in order to achieve various levels of thermal control. The focus of this paper is to highlight the Vari-E Coating MEMS instrument, with an emphasis on the Electronic Control Unit responsible for operating the MEMS device. The Test & Evaluation approach, along with the results, is specific for application on ST-5, yet the information provides a guideline for future experiments and/or thermal applications on the exterior structure of a spacecraft.

Author

Emittance; Microelectromechanical Systems; Spacecraft Instruments; Temperature Control; Thermal Control Coatings; Infrared Radiation

20030025777 NASA Goddard Space Flight Center, Greenbelt, MD, USA

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR)

Poivey, Christian; Barth, Janet L.; LaBel, Ken A.; Gee, George; Safren, Harvey; [2003]; 5 pp.; In English; IEEE Nuclear and Space Radiation Effect Conference, 21-25 Jul. 2003, Monterey, CA, USA; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy

This paper presents Single Event Effect (SEE) in-flight data on Solid State Recorders (SSR) that have been collected over

a long period of time for two NASA spacecraft: Orbview-2 and XTE. SEE flight data on solid-state memories give an opportunity to study the behavior in space of SEE sensitive commercial devices. The actual Single Event Upset (SEU) rates can be compared with the calculated rates based on environment models and ground test data. The SEE mitigation schemes can also be evaluated in actual implementation. A significant amount of data has already been published concerning observed SEE effects on memories in space. However, most of the data presented cover either a short period of time or a small number of devices. The data presented here has been collected on a large number of devices during several years. This allows statistically significant information about the effect of space weather fluctuations on SEU rates, and the effectiveness of SEE countermeasures used to be analyzed. Only Orbview-2 data is presented in this summary. XTE data will be included in the final paper.
Author
Single Event Upsets; Spacecraft Electronic Equipment; Charged Particles; Data Processing; Mathematical Models; Space Weather; Solar Activity Effects

20030025780 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite
Ward, David K.; Davis, Gary T.; O'Donnell, James R., Jr.; [2002]; 11 pp.; In English; AIAA Guidance and Control Conference, Aug. 2002, Monterey, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The on-orbit success of the Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control System can partially be attributed to the performance of a hardware suite chosen to meet the complex attitude determination and control requirements of the mission. To meet these requirements, a diverse set of components was used. The set included two Lockheed Martin AST-201 star trackers, two Kearfott Two-Axis Rate Assemblies mounted to provide X, Y and redundant Z-axis rates, two Adcole Digital Sun Sensor heads sharing one set of electronics, twelve Adcole Coarse Sun Sensor eyes, three Ithaco E-sized Reaction Wheel Assemblies, a Propulsion Subsystem that employed eight Primex Rocket Engine Modules, and a pair of Goddard-designed Attitude Control Electronics which connect all of the components to the spacecraft processor. The performance of this hardware is documented, as are some of the spacecraft accommodations and lessons learned that came from working with this particular set of hardware.
Author
Microwave Anisotropy Probe; Spacecraft Control; Control Systems Design; Spacecraft Guidance; Space Navigation; Electronic Equipment; Applications Programs (Computers)

20030031332 NASA Goddard Space Flight Center, Greenbelt, MD, USA
NASA Thermal Control Technologies for Robotic Spacecraft
Swanson, Theodore D.; Birur, Gajanana C.; January 2003; 24 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Technology development is inevitably a dynamic process in search of an elusive goal. It is never truly clear whether the need for a particular technology drives its development, or the existence of a new capability initiates new applications. Technology development for the thermal control of spacecraft presents an excellent example of this situation. Nevertheless, it is imperative to have a basic plan to help guide and focus such an effort. Although this plan will be a living document that changes with time to reflect technological developments, perceived needs, perceived opportunities, and the ever-changing funding environment, it is still a very useful tool. This presentation summarizes the current efforts at NASA/Goddard and NASA/JPL to develop new thermal control technology for future robotic NASA missions.
Author
Spacecraft Temperature; Temperature Control; Heat Pipes; Surface Properties; Thermostats; Heat Storage; Unmanned Spacecraft; Spacecraft Design

20030031349 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints
Naasz, Bo; Hall, Christopher; Berry, Matthew; Hy-Young, Kim; [2003]; 18 pp.; In English; Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, PR, USA Minor Outlying Islands; Original contains black and white illustrations
Report No.(s): AAS 03-100; Copyright; Avail: CASI; A03, Hardcopy

Small satellites tend to be power-limited, so that actuators used to control the orbit and attitude must compete with each other as well as with other subsystems for limited electrical power. The Virginia Tech nanosatellite project, HokieSat, must use its limited power resources to operate pulsed-plasma thrusters for orbit control and magnetic torque coils for attitude

control, while also providing power to a GPS receiver, a crosslink transceiver, and other subsystems. The orbit and attitude control strategies were developed independently. The attitude control system is based on an application of Linear Quadratic Regulator (LQR) to an averaged system of equations, whereas the orbit control is based on orbit element feedback. In this paper we describe the strategy for integrating these two control systems and present simulation results to verify the strategy.
Author
Nanosatellites; Satellite Attitude Control; Trajectory Control; Systems Integration; Control Systems Design; Orbit Determination; Control Simulation; Equations Of Motion; Satellite Orbits

20030032201 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper
Maly, Joseph R.; Reed, Benjamin B.; Viens, Michael J.; Parker, Bradford H.; Pendleton, Scott C.; [2003]; 13 pp.; In English; International Society for Optical Engineering: Smart Structures and Materials, Mar. 2003, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

During the March 2002 Servicing Mission by Space Shuttle (STS 109), the Hubble Space Telescope (HST) was refurbished with two new solar arrays that now provide all of its power. These arrays were built with viscoelastic/titanium dampers, integral to the supporting masts, which reduce the interaction of the wing bending modes with the Telescope. Damping of over 3\% of critical was achieved. To assess the damper s ability to maintain nominal performance over the 10-year on-orbit design goal, material specimens were subjected to an accelerated life test. The test matrix consisted of scheduled events to expose the specimens to pre-determined combinations of temperatures, frequencies, displacement levels, and numbers of cycles. These exposure events were designed to replicate the life environment of the damper from fabrication through testing to launch and life on-orbit. To determine whether material degradation occurred during the exposure sequence, material performance was evaluated before and after the accelerated aging with complex stiffness measurements. Based on comparison of pre- and post-life-cycle measurements, the material is expected to maintain nominal performance through end of life on-orbit. Recent telemetry from the Telescope indicates that the dampers are performing nominally.
Author
Viscoelasticity; Solar Arrays; Hubble Space Telescope; Accelerated Life Tests

20030032209 NASA Goddard Space Flight Center, Greenbelt, MD, USA
MAP Propulsion System Thermal Design
Mosier, Carol L.; [2003]; 7 pp.; In English; STAIF 2003, 2-6 Feb. 2003, Albequerque, NM, USA; No Copyright; Avail: CASI; A02, Hardcopy

The propulsion system of the Microwave Anisotropy Probe (MAP) had stringent requirements that made the thermal design unique. To meet instrument stability requirements the system had to be designed to keep temperatures of all components within acceptable limits without heater cycling. Although the spacecraft remains at a fixed 22 sun angle at L2, the variations in solar constant, property degradation, and bus voltage range all significantly affect the temperature. Large portions of the fuel lines are external to the structure and all components are mounted to non-conductive composite structure. These two facts made the sensitivity to the MLI effective emissivity and bus temperature very high. Approximately two years prior to launch the propulsion system was redesigned to meet MAP requirements. The new design utilized hardware that was already installed in order to meet schedule constraints. The spacecraft design and the thermal requirements were changed to compensate for inadequacies of the existing hardware. The propulsion system consists of fuel lines, fill and drain lines/valve, eight thrusters, a HXCM, and a propulsion tank. A voltage regulator was added to keep critical components within limits. Software was developed to control the operational heaters. Trim resistors were put in series with each operational heater circuits and the tank survival heater. A highly sophisticated test program, which included real time model correlation, was developed to determine trim resistors sizes. These trim resistors were installed during a chamber break and verified during thermal balance testing.
Author
Microwave Anisotropy Probe; Systems Engineering; Thermal Vacuum Tests; Spacecraft Design; Propulsion System Configurations; Thermal Analysis

20030032247 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center
Ericsson, Aprille Joy; [2002]; 15 pp.; In English; National Technical Association Meeting, 25-27 Sep. 2002, Las Vegas, NV, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

A viewgraph presentation on guidance navigation and control innovations at the NASA Goddard Space Flight Center is presented. The topics include: 1) NASA's vision; 2) NASA's Mission; 3) Earth Science Enterprise (ESE); 4) Guidance, Navigation and Control Division (GN&C); 5) Landsat-7 Earth Observer-1 Co-observing Program; and 6) NASA ESE Vision. CASI

NASA Programs; Navigation; Spacecraft Guidance; Earth Sciences; Spacecraft Control

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

20030022662 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Hubble Space Telescope On-orbit NiH2 Battery Performance

Rao, Gopalakrishna M.; Krol, Stanley J., Jr.; July 2002; 6 pp.; In English; 2002 IECE Conference, 29 Jul. - 1 aug. 2002, Washington, DC, USA; Original contains black and white illustrations

Report No.(s): IECEC Paper 2002; Copyright; Avail: CASI; A02, Hardcopy

This paper summarizes the Hubble Space Telescope (HST) nickel-hydrogen (NiH2) battery performance from launch to the present time. Over the life of HST vehicle configuration, charge system degradation and failures together with thermal design limitations have had a significant effect on the capacity of the HST batteries. Changes made to the charge system configuration in order to protect against power system failures and to maintain battery thermal stability resulted in undercharging of the batteries. This undercharging resulted in decreased usable battery capacity as well as battery cell voltage/capacity divergence. This cell divergence was made evident during on-orbit battery capacity measurements by a relatively shallow slope of the discharge curve following the discharge knee. Early efforts to improve the battery performance have been successful. On-orbit capacity measurement data indicates increases in the usable battery capacity of all six batteries as well as improvements in the battery cell voltage/capacity divergence. Additional measures have been implemented to improve battery performance, however, failures within the HST Power Control Unit (PCU) have prevented verification of battery status. As this PCU fault prevents the execution of on-orbit capacity testing, the HST Project has based the battery capacity on trends, which utilizes previous on-orbit battery capacity test data, for science mission and servicing mission planning. The Servicing Mission 38 (SM-3B) in March 2002 replaced the faulty PCU. Following the servicing mission, on-orbit capacity test resumed. A summary of battery performance is reviewed since launch in this paper.
Author

Nickel Hydrogen Batteries; Charge Efficiency; Spacecraft Power Supplies; Hubble Space Telescope; Life (Durability); Design Analysis; Battery Chargers; Thermodynamic Properties

20030025258 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Balloon Borne Arc-Second Pointer Feasibility Study

Ward, Philip R.; DeWeese, Keith D.; January 2003; 1 pp.; In English; 16th ESA Symposium on European Rocket and Balloon Programmes and Related Research, 2-5 Jun. 2003, Saint Gallen-Bodensee, Switzerland; No Copyright; Avail: CASI; A01, Hardcopy

For many years scientists have been utilizing stratospheric balloons as low-cost platforms on which to conduct space science experiments. A major hurdle in extending the range of experiments for which these vehicles are useful has been the imposition of the gondola dynamics on the accuracy with which an instrument can be kept pointed at a celestial target. A significant number of scientists have sought the ability to point their instruments with jitter in the arc-second range. This paper presents the design and analysis of a stratospheric balloon borne pointing system that is able to meet this requirement. The foundation for a high fidelity controller simulation is presented. The flexibility of the flight train is represented through generalized modal analysis. A multiple controller scheme is introduced for coarse and fine pointing. Coarse azimuth pointing is accomplished by an established pointing system, with extensive flight history, residing above the gondola structure. A pitch-yaw gimbal mount is used for fine pointing, providing orthogonal axes when nominally on target. Fine pointing actuation is from direct drive dc motors, eliminating backlash problems. An analysis of friction nonlinearities and a demonstration of the necessity in eliminating static fiction are provided. A unique bearing hub design is introduced that eliminates static fiction from the system dynamics. A control scheme involving linear accelerometers for enhanced disturbance rejection is also

presented. Results from a linear analysis of the total system and the high fidelity simulation are given. This paper establishes that the proposed control strategy can be made robustly stable with significant design margins. Also demonstrated is the efficacy of the proposed system in rejecting disturbances larger than those considered realistic. Finally, we see that sub arc-second pointing stability can be achieved for a large instrument pointing at an inertial target.
Author
Balloon-Borne Instruments; Meteorological Balloons; Stratosphere; Pointing Control Systems; Feasibility Analysis

20030025281 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Timekeeping for the Space Technology 5 (ST-5) Mission
Raphael, Dave; Luers, Phil; Sank, Victor; Jackson, George; [2002]; 10 pp.; In English; 2003 IEEE Aerospace Conference, 8-15 Mar. 2003, Big Sky, MT, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS5-99124
Report No.(s): IEEEAC Paper-1418; Copyright; Avail: CASI; A02, Hardcopy

Space Technology 5, or better known as ST-5, is a space technology development mission in the New Millennium Program (NMP) and NASA s first experiment in the design of miniaturized satellite constellations. The mission will design, integrate and launch multiple spacecraft into an orbit high above the Earth s protective magnetic field known as the magnetosphere. Each spacecraft incorporates innovative technology and constellation concepts which will be instrumental in future space science missions. A total of three ST-5 spacecraft will be launched as secondary payloads into a highly elliptical geo-synchronous transfer orbit, and will operate as a 3-element constellation for a minimum duration of 90 days. In order to correlate the time of science measurements with orbit position relative to the Earth, orbit position in space (with respect to other objects in space) and/or with events measured on Earth or other spacecraft, accurate knowledge of spacecraft and ground time is needed. Ground time as used in the USA (known as Universal Time Coordinated or UTC) is maintained by the U.S. Naval Observatory. Spacecraft time is maintained onboard within the Command and Data Handling (C&DH) system. The science requirements for ST-5 are that spacecraft time and ground time be correlatable to each other, with some degree of accuracy. Accurate knowledge of UTC time on a spacecraft is required so that science measurements can be correlated with orbit position relative to the Earth, orbit position in space and with events measured on Earth or other spacecraft. The most crucial parameter is not the clock oscillator frequency, but more importantly, how the clock oscillator frequency varies with time or temperature (clock oscillator drift). Even with an incorrect clock oscillator frequency, if there were no drift, the frequency could be assessed by comparing the spacecraft clock to a ground clock during a few correlation events. Once the frequency is accurately known, it is easy enough to make a regular adjustment to the spacecraft clock or to calculate the correct ground time for a given spacecraft clock time. The oscillator frequency, however, is temperature dependent, drifts with age and is affected by radiation; hence, repeated correlation measurements are required.
Author
Aerospace Engineering; Satellite Constellations; Space Missions; Technology Utilization; Miniaturization; Autonomous Spacecraft Clocks

20030025345 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification.
King, Terry; Teverovsky, Alexander; Leidecker, Henning; August 2002; 46 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The use of Plastic Encapsulated Microcircuits (PEMs) is permitted on NASA Goddard Space Flight Center (GSFC) spaceflight applications, provided each use is thoroughly evaluated for thermal, mechanical, and radiation implications of the specific application and found to meet mission requirements. PEMs shall be selected for their functional advantage and availability, not for cost saving; the steps necessary to ensure reliability usually negate any initial apparent cost advantage. A PEM shall not be substituted for a form, fit and functional equivalent, high reliability, hermetic device in spaceflight applications. Due to the rapid change in wafer-level designs typical of commercial parts and the unknown traceability between packaging lots and wafer lots, lot specific testing is required for PEMs, unless specifically excepted by the Mission Assurance Requirements (MAR) for the project. Lot specific qualification, screening, radiation hardness assurance analysis and/or testing, shall be consistent with the required reliability level as defined in the MAR. Developers proposing to use PEMs shall address the following items in their Performance Assurance Implementation Plan: source selection (manufacturers and distributors), storage conditions for all stages of use, packing, shipping and handling, electrostatic discharge (ESD), screening and qualification testing, derating, radiation hardness assurance, test house selection and control, data collection and retention.
Author
Encapsulated Microcircuits; Microelectronics; Wafers; Materials Selection; Mechanical Properties; Quality Control; Education

20030025395 NASA Goddard Space Flight Center, Greenbelt, MD, USA

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics

LeBel, Kenneth A.; Poivey, Christian; Barth, Janet L.; [2003]; 25 pp.; In English; NATO Advanced Research Workshop on Effects of Space Weather on Technology Infrastructure, 25-29 Mar. 2003, Rhodes, Greece; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation presents an overview of the use of in-flight science data to review the radiation effects on commercial off the shelf (COTS) electronics used in recent spacecraft missions. The authors review the hazards that the space radiation environment pose for spacecraft electronics. They specifically discuss long term effects such as total ionizing dose (TID) and short term effects like single particle events (SEE). The advantages of using COTS electronics despite not being radiation hardened are mentioned. The reasons cite for tracking in-flight performance of COTS electronics include: anomaly resolution, validate ground tests and environmental predictions and provide lessons for future designers. Sample radiation impacts of science data from the following missions are analyzed: SOHO/LASCO 3 Coronograph, Microwave Anisotrophy Probe, Hubble Space Telescope and Chandra X-Ray Observatory.

Author

Commercial Off-The-Shelf Products; Radiation Effects; Spacecraft Electronic Equipment; Radiation Hazards; Anomalies; Data Processing; Performance Prediction; Extraterrestrial Radiation

20030025415 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics

OBryan, Martha V.; LaBel, Kenneth A.; Reed, Robert A.; Ladbury, Ray L.; Howard, James W., Jr.; Kniffin, Scott D.; Poivey, Christian; Buchner, Stephen P.; Bings, John P.; Titus, Jeff L.; [2002]; 26 pp.; In English; 2002 IEEE Nuclear and Space Radiation Effects Conference, 15-19 Jul. 2002, Phoenix, AZ, USA; Original contains black and white illustrations

Contract(s)/Grant(s): DTRA-IACRO-01-4050/0001278; Copyright; Avail: CASI; A03, Hardcopy

We present data on the vulnerability of a variety of candidate spacecraft electronics to proton and heavy ion induced single event effects, total ionizing dose and proton-induced damage. Devices tested include optoelectronics, digital, analog, linear bipolar, hybrid devices, Analog-to-Digital Converters (ADCs), Digital-to-Analog Converters (DACs), and DC-DC converters, among others.

Author

Spacecraft Electronic Equipment; Radiation Damage; Vulnerability; Single Event Upsets; Destructive Tests

20030025696 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1)

Folta, David; Hawkins, Albin; January 2002; 11 pp.; In English; AlAA/AAS Astrodynamics Specialist Conference, 5-8 Aug. 2002, Monterey, CA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

NASA's first autonomous formation flying mission completed its primary goal of demonstrating an advanced technology called Enhanced Formation Flying. To enable this technology, a team at the Goddard Space Flight Center implemented a universal 3-axis formation flying algorithm in an autonomous executive flight code onboard the New Millennium Program's (NMP) Earth Observing-1 (EO-1) spacecraft. This paper describes the mathematical background of the autonomous formation flying algorithm, the onboard flight design and the validation results of this unique system. Results from fully autonomous maneuver control are presented as comparisons between the onboard EO-1 operational autonomous control system called AutoCon(trademark), its ground-based predecessor used in operations, and the original standalone algorithm. Maneuvers discussed encompass reactionary, routine formation maintenance, and inclination control. Orbital data is also examined to verify that all formation flying requirements were met.

Author

Algorithms; Autonomy; Formation Flying; Spacecraft Control

20030025708 AI Solutions, Inc., Lanham, MD, USA

Designing Phase 2 for the Double-Lunar Swingby of the Magnetospheric Multiscale Mission (MMS)

Edery, Ariel; [2002]; 5 pp.; In English; 13th Annual AAS/AIAA Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, Puerto Rico; No Copyright; Avail: CASI; A01, Hardcopy

The Magnetospheric Multiscale (MMS) mission is a formation flying mission that consists of four distinct phases: phases 1 and 2 are low-inclination highly elliptical orbits (HEO), phase 3 is a double-lunar swingby which transfers phase 2 to phase

4, a high-inclination HE0 orbit. Phase 2 is designed to reach the first lunar swingby of phase 3 in the most efficient fashion. It is shown that when the orientation of the line of apsides of phase 2 is properly chosen, no extra Delta-V is required beyond what is typically needed to raise apogee to lunar distance.
Author
Lunar Phases; Planetary Magnetospheres; Abort Trajectories

20030032244 ManTech International Corp., Greenbelt, MD, USA NSI Technology Services Corp., Greenbelt, MD, USA
Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup
Harris, Patrick K.; Block, Nathan F.; [2002]; 4 pp.; In English; 2003 IEEE Symposium on EMC, 18 Aug. 2003, Reston, VA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS5-32537; No Copyright; Avail: CASI; A01, Hardcopy

The MIL-STD-462 CS02 conducted susceptibility test setup, performed during electromagnetic compatibility (EMC) testing, consists of an audio transformer with the secondary used as an inductor and a large capacitor. Together, these two components form an L-type low-pass filter to minimize the injected test signal input into the power source. Some flight hardware power input configurations are not compatible with this setup and break into oscillation when powered up. This can damage flight hardware and caused a catastrophic failure to an item tested in the Goddard Space Flight Center (GSFC) Large EMC Test Facility.
Author
Damage; Transformers; Electromagnetic Compatibility; Capacitors; Low Pass Filters

20030032246 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback
Cheng, Victore H. L.; Leitner, Jesse A.; January 28, 2003; 21 pp.; In English; AIAA Guidance, Navigation, and Control Conference, 11-13 Aug. 2003, Austin, TX, USA; Copyright; Avail: CASI; A03, Hardcopy

Numerous space interferometry missions are planned for the next decade to verify different enabling technologies towards very-long-baseline interferometry to achieve high-resolution imaging and high-precision measurements. These objectives will require coordinated formations of spacecraft separately carrying optical elements comprising the interferometer. High-precision sensing and control of the spacecraft and the interferometer-component payloads are necessary to deliver sub-wavelength accuracy to achieve the scientific objectives. For these missions, the primary scientific product of interferometer measurements may be the only source of data available at the precision required to maintain the spacecraft and interferometer-component formation. A concept is studied for detecting the interferometer's optical configuration errors based on information extracted from the interferometer sensor output. It enables precision control of the optical components, and, in cases of space interferometers requiring formation flight of spacecraft that comprise the elements of a distributed instrument, it enables the control of the formation flying vehicles because independent navigation or ranging sensors cannot deliver the high-precision metrology over the entire required geometry. Since the concept can act on the quality of the interferometer output directly, it can detect errors outside the capability of traditional metrology instruments, and provide the means needed to augment the traditional instrumentation to enable enhanced performance. Specific analyses performed in this study include the application of signal-processing and image-processing techniques to solve the problems of interferometer aperture baseline control, interferometer pointing, and orientation of multiple interferometer aperture pairs.
Author
Interferometers; Feedback Control; Interferometry; Metrology; Spacecraft Instruments; Optical Equipment; Control Systems Design; Error Analysis

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*.

20030022695 ManTech International Corp.
Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory
Johnson, Chris; Hinkle, R. Kenneth, Technical Monitor; October 2002; 3 pp.; In English; 22nd IEST-NASA/ASTM/AIAA/CSA Space Simulation Conference, 21-24 Oct. 2002
Contract(s)/Grant(s): NAS5-02034; No Copyright; Avail: CASI; A01, Hardcopy

The specific heater control requirements for the thermal vacuum and thermal balance testing of the Microwave Anisotropy Probe (MAP) Observatory at the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland are described. The testing was conducted in the 10m wide x 18.3m high Space Environment Simulator (SES) Thermal Vacuum Facility. The MAP thermal testing required accurate quantification of spacecraft and fixture power levels while minimizing heater electrical emissions. The special requirements of the MAP test necessitated construction of five (5) new heater racks.
Author
Microwave Anisotropy Probe; Observatories; Thermal Vacuum Tests; Power Supplies; Control Equipment; Heating Equipment; Spacecraft Temperature

20030022776 NASA Glenn Research Center, Cleveland, OH, USA
Catalyzed Ignition of Bipropellants in Microtubes
Schneider, Steven J.; Boyarko, George A.; Sung, Chih-Jen; February 2003; 17 pp.; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS-22-755-04-08
Report No.(s): NASA/TM-2003-212206; NAS 1.15:212206; E-13810; AIAA Paper 2003?0674; Copyright; Avail: CASI; A03, Hardcopy

This paper addresses the need to understand the physics and chemistry involved in propellant combustion processes in micro-scale combustors for propulsion systems on micro-spacecraft. These spacecraft are planned to have a mass less than 50 kilograms with attitude control estimated to be in the 10 milli-Newton thrust class. These combustors are anticipated to be manufactured using Micro Electrical Mechanical Systems (MEMS) technology and are expected to have diameters approaching the quenching diameter of the propellants. Combustors of this size are expected to benefit significantly from surface catalysis processes. Miniature flame tube apparatus is chosen for this study because microtubes can be easily fabricated from known catalyst materials and their simplicity in geometry can be used in fundamental simulations to more carefully characterize the measured heat transfer and pressure losses for validation purposes. Experimentally, we investigate the role of catalytically active surfaces within 0.4 and 0.8 mm internal diameter micro-tubes, with special emphases on ignition and extinction processes in fuel rich gaseous hydrogen and gaseous oxygen. Flame thickness and reaction zone thickness calculations predict that the diameters of our test apparatus are below the quenching diameter of the propellants in sub-atmospheric tests. Temperature and pressure rises in resistively heated platinum and palladium micro-tubes are used as an indication of exothermic reactions. Specific data on mass flow versus preheat temperature required to achieve ignition are presented.
Author
Chemical Propulsion; Spacecraft Propulsion; Rocket Engines; Low Thrust Propulsion; Liquid Rocket Propellants; Combustion Physics; Combustion Chemistry; Microstructure

20030025254 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem
Hughes, Steven P.; Mailhe, Laurie M.; Guzman, Jose J.; February 2003; 20 pp.; In English; 26th Annual Guidance and Control Conference, Feb. 2003, Breckenridge, CO., USA; Copyright; Avail: CASI; A03, Hardcopy

In this paper we present, a comparison of trajectory optimization approaches for the minimum fuel rendezvous problem. Both indirect and direct methods are compared for a variety of test cases. The indirect approach is based on primer vector theory. The direct approaches are implemented numerically and include Sequential Quadratic Programming (SQP). Quasi-Newton and Nelder-Meade Simplex. Several cost function parameterizations are considered for the direct approach. We choose one direct approach that appears to be the most flexible. Both the direct and indirect methods are applied to a variety of test cases which are chosen to demonstrate the performance of each method in different flight regimes. The first test case is a simple circular-to-circular coplanar rendezvous. The second test case is an elliptic-to-elliptic line of apsides rotation. The final test case is an orbit phasing maneuver sequence in a highly elliptic orbit. For each test case we present a comparison of the performance of all methods we consider in this paper.
Author
Trajectory Optimization; Parameterization; Fuel Control

20030025383 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Development of a Thrust Stand to Meet LISA Mission Requirements
Willis, William D., III; Zakrzwski, Charles M.; Merkowitz, Stephen M.; [2002]; 9 pp.; In English; AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 7-10 Jul. 2002; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

A thrust stand has been built to measure the force-noise produced by electrostatic micro-Newton (muN) thrusters. The LISA mission's Disturbance Reduction System (DRS) requires thrusters that are capable of producing continuous thrust levels between 1-100 muN with a resolution of 0.1 muN. The stationary force-noise produced by these thrusters must not exceed 0.1 muN/dHz in the measurement bandwidth 10(exp -4) to 1 Hz. The LISA Thrust Stand (LTS) is a torsion-balance type thrust stand designed to meet the following requirements: stationary force-noise measurements from l0(-4) to 1 Hz with 0.1 muN/dHz sensitivity, absolute thrust measurements from 1-100 muN with better than 0.1 muN resolution, and dynamic thruster response from to 10 Hz. The LTS employs a unique vertical configuration, autocollimator for angular position measurements, and electrostatic actuators that are used for dynamic pendulum control and null-mode measurements. Force-noise levels are measured indirectly by characterizing the thrust stand as a spring-mass system. The LTS was initially designed to test the indium FEEP thruster developed by the Austrian Research Center in Seibersdorf (ARCS), but can be modified for testing other thrusters of this type.
Author
Thrust Measurement; Thrust; Dynamic Response; Dynamic Control; Bandwidth; LISA (Observatory)

20030025704 NASA Langley Research Center, Hampton, VA, USA
Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition
Smart, Michael K.; Trexler, Carl A.; [2003]; 12 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2003-0012; No Copyright; Avail: CASI; A03, Hardcopy

Wind-tunnel testing of a hypersonic inlet with rectangular-to-elliptical shape transition has been conducted at Mach 4.0. These tests were performed to investigate the starting and back-pressure limits of this fixed-geometry inlet at conditions well below the Mach 5.7 design point. Results showed that the inlet required side spillage holes in order to self-start at Mach 4.0. Once started, the inlet generated a compression ratio of 12.6, captured almost 80\% of available air and withstood a back-pressure ratio of 30.3 relative to tunnel static pressure. The spillage penalty for self-starting was estimated to be 4\% of available air. These experimental results, along with previous experimental results at Mach 6.2 indicate that fixed-geometry inlets with rectangular-to-elliptical shape transition are a viable configuration for airframe-integrated scramjets that operate over a significant Mach number range. Nomenclature
Author
Hypersonic Inlets; Mach Number; Wind Tunnel Tests; Shapes; Pressure Ratio

20030027869 NASA Glenn Research Center, Cleveland, OH, USA
Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution
Soltis, James V.; February 1, 2003; 52 pp.; In English; Space Technology and Application International Forum, 1-2 Feb. 2003, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A04, Hardcopy

Control and integration of energy conversion in space nuclear reactor power systems is discussed. Specific topics include: Systems Engineering of the PMAD subsystem and interference with other subsystems, including environmental and mission unique considerations, and integration issues with payloads.
Author
Nuclear Propulsion; Energy Conversion; Systems Engineering; Spacecraft Control; Spacecraft Power Supplies; Nuclear Reactors

20030028448 NASA Glenn Research Center, Cleveland, OH, USA
Innovative Airbreathing Propulsion Concepts for High-speed Applications
Whitlow, Woodrow, Jr.; [2002]; 22 pp.; In English; 23rd Congress of International Council of the Aeronautical Sciences, 9-12 Sep. 2002; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The current cost to launch payloads to low earth orbit (LEO) is approximately loo00 U.S. dollars ($) per pound ($22000 per kilogram). This high cost limits our ability to pursue space science and hinders the development of new markets and a productive space enterprise. This enterprise includes NASA's space launch needs and those of industry, universities, the military, and other U.S. government agencies. NASA's Advanced Space Transportation Program (ASTP) proposes a vision of the future where space travel is as routine as in today's commercial air transportation systems. Dramatically lower launch costs will be required to make this vision a reality. In order to provide more affordable access to space, NASA has established new goals in its Aeronautics and Space Transportation plan. These goals target a reduction in the cost of launching payloads

to LEO to $lo00 per pound ($2200 per kilogram) by 2007 and to $100'~ per pound by 2025 while increasing safety by orders of magnitude. Several programs within NASA are addressing innovative propulsion systems that offer potential for reducing launch costs. Various air-breathing propulsion systems currently are being investigated under these programs. The NASA Aerospace Propulsion and Power Base Research and Technology Program supports long-term fundamental research and is managed at GLenn Research Center. Currently funded areas relevant to space transportation include hybrid hyperspeed propulsion (HHP) and pulse detonation engine (PDE) research. The HHP Program currently is addressing rocket-based combined cycle and turbine-based combined cycle systems. The PDE research program has the goal of demonstrating the feasibility of PDE-based hybrid-cycle and combined cycle propulsion systems that meet NASA's aviation and access-to-space goals. The ASTP also is part of the Base Research and Technology Program and is managed at the Marshall Space Flight Center. As technologies developed under the Aerospace Propulsion and Power Base Research and Technology Program mature, they are incorporated into ASTP. One example of this is rocket-based combined cycle systems that are being considered as part of ASTP. The NASA Ultra Efficient Engine Technology (UEET) Program has the goal of developing propulsion system component technology that is relevant to a wide range of vehicle missions. In addition to subsonic and supersonic speed regimes, it includes the hypersonic speed regime. More specifically, component technologies for turbine-based combined cycle engines are being developed as part of UEET.
Author

Air Breathing Engines; Cost Reduction; Hybrid Propulsion; Launch Costs; Low Earth Orbits; Propulsion System Performance; Rocket-Based Combined-Cycle Engines; Hypersonic Speed

20030031381 National Center for Microgravity Research on Fluids and Combusiton, Cleveland, OH, USA

The Filtered Abel Transform and Its Application in Combustion Diagnostics

Simons, Stephen N., Technical Monitor; Yuan, Zeng-Guang; March 2003; 16 pp.; In English; 1995 Fall Meeting, Western States Section, 30-31 Oct. 1995, Stanford, CA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NCC3?975; WBS 22-101-52-01

Report No.(s): NASA/CR-2003-212121; E-13773; NAS 1.26:212121; No Copyright; Avail: CASI; A03, Hardcopy

Many non-intrusive combustion diagnosis methods generate line-of-sight projections of a flame field. To reconstruct the spatial field of the measured properties, these projections need to be deconvoluted. When the spatial field is axisymmetric, commonly used deconvolution method include the Abel transforms, the onion peeling method and the two-dimensional Fourier transform method and its derivatives such as the filtered back projection methods. This paper proposes a new approach for performing the Abel transform method is developed, which possesses the exactness of the Abel transform and the flexibility of incorporating various filters in the reconstruction process. The Abel transform is an exact method and the simplest among these commonly used methods. It is evinced in this paper that all the exact reconstruction methods for axisymmetric distributions must be equivalent to the Abel transform because of its uniqueness and exactness. Detailed proof is presented to show that the two dimensional Fourier methods when applied to axisymmetric cases is identical to the Abel transform. Discrepancies among various reconstruction method stem from the different approximations made to perform numerical calculations. An equation relating the spectrum of a set of projection date to that of the corresponding spatial distribution is obtained, which shows that the spectrum of the projection is equal to the Abel transform of the spectrum of the corresponding spatial distribution. From the equation, if either the projection or the distribution is bandwidth limited, the other is also bandwidth limited, and both have the same bandwidth. If the two are not bandwidth limited, the Abel transform has a bias against low wave number components in most practical cases. This explains why the Abel transform and all exact deconvolution methods are sensitive to high wave number noises. The filtered Abel transform is based on the fact that the Abel transform of filtered projection data is equal to an integral transform of the original projection data with the kernel function being the Abel transform of the filtering function. The kernel function is independent of the projection data and can be obtained separately when the filtering function is selected. Users can select the best filtering function for a particular set of experimental data. When the kernal function is obtained, it can be used repeatedly to a number of projection data sets (rovs) from the same experiment. When an entire flame image that contains a large number of projection lines needs to be processed, the new approach significantly reduces computational effort in comparison with the conventional approach in which each projection data set is deconvoluted separately. Computer codes have been developed to perform the filter Abel transform for an entire flame field. Measured soot volume fraction data of a jet diffusion flame are processed as an example.
Author

Abel Function; Combustion; Diagnosis; Kernel Functions; Fourier Transformation; Diffusion Flames; Axisymmetric Flow

20030032186 NASA Marshall Space Flight Center, Huntsville, AL, USA

Magnetic Flux Compression Experiments Using Plasma Armatures

Turner, M. W.; Hawk, C. W.; Litchford, R. J.; March 2003; 37 pp.; In English; Original contains black and white illustrations
Report No.(s): NASA/TP-2003-212341; NAS 1.60:212341; M-1069; No Copyright; Avail: CASI; A03, Hardcopy

Magnetic flux compression reaction chambers offer considerable promise for controlling the plasma flow associated with various micronuclear/chemical pulse propulsion and power schemes, primarily because they avoid thermalization with wall structures and permit multicycle operation modes. The major physical effects of concern are the diffusion of magnetic flux into the rapidly expanding plasma cloud and the development of Rayleigh-Taylor instabilities at the plasma surface, both of which can severely degrade reactor efficiency and lead to plasma-wall impact. A physical parameter of critical importance to these underlying magnetohydrodynamic (MHD) processes is the magnetic Reynolds number (R(sub m), the value of which depends upon the product of plasma electrical conductivity and velocity. Efficient flux compression requires R(sub m) less than 1, and a thorough understanding of MHD phenomena at high magnetic Reynolds numbers is essential to the reliable design and operation of practical reactors. As a means of improving this understanding, a simplified laboratory experiment has been constructed in which the plasma jet ejected from an ablative pulse plasma gun is used to investigate plasma armature interaction with magnetic fields. As a prelude to intensive study, exploratory experiments were carried out to quantify the magnetic Reynolds number characteristics of the plasma jet source. Jet velocity was deduced from time-of-flight measurements using optical probes, and electrical conductivity was measured using an inductive probing technique. Using air at 27-inHg vacuum, measured velocities approached 4.5 km/s and measured conductivities were in the range of 30 to 40 kS/m.
Author

Electrical Resistivity; Plasma Compression; Magnetic Flux; Reynolds Number; Plasma Jets; Plasma Dynamics; Stability; Chemical Propulsion

23
CHEMISTRY AND MATERIALS (GENERAL)

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

20030020946 NASA Glenn Research Center, Cleveland, OH, USA

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis

Jin, Michael H.-C.; Banger, Kulbinder K.; Harris, Jerry D.; Hepp, Aloysius F.; May 12, 2003; 3 pp.; In English; 3rd World Conference on Photovoltaic Energy Conversion, 12-16 May 2003, Osaka, Japan; Copyright; Avail: CASI; A01, Hardcopy

CuInS2 was deposited by spray pyrolysis using single-source precursors synthesized in-house. Films with either (112) or (204/220) preferred orientation always showed Cu-rich and In-rich composition respectively. The In-rich (204/220)-oriented films always contained a secondary phase evaluated as an In-rich compound, and the hindrance of (112)-oriented grain growth was confirmed by glancing angle X-ray diffraction. In conclusion, only the Cu-rich (112)-oriented films with dense columnar grains can be prepared without the secondary In-rich compound. The effect of extra Cu on the grain size and the solar cell results will be also presented.
Author

Films; Textures; Grain Size; Copper Sulfides; Indium Sulfides; Pyrolysis

20030025233 Iowa Univ., Iowa City, IA, USA

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes

Wiencek, John M.; [2002]; 4 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG8-1588; No Copyright; Avail: CASI; A01, Hardcopy

The overall goal of this project was to maximize the reuseability of spent fermentation media. Supported emulsion liquid membrane separation, a highly efficient extraction technique, was used to remove inhibitory byproducts during fermentation; thus, improve the yield while reducing the need for fresh water. The key objectives of this study were: (1) Develop an emulsion liquid membrane system targeting low molecular weight organic acids which has minimal toxicity on a variety of microbial systems. (2) Conduct mass transfer studies to allow proper modeling and design of a supported emulsion liquid membrane system. (3) Investigate the effect of gravity on emulsion coalescence within the membrane unit. (4) Access the effect of water re-use on fermentation yields in a model microbial system. and (5) Develop a perfusion-type fermentor utilizing a supported

emulsion liquid membrane system to control inhibitory fermentation byproducts (not completed due to lack of funds)
Author
Reuse; Fermentation; Emulsions; Membranes; Microorganisms; Gravitational Effects; Extraction

24
COMPOSITE MATERIALS

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

20030020862 North Carolina Agricultural and Technical State Univ., Greensboro, NC, USA
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications
Shivakumar, Kunigal; Argade, Shyam; March 28, 2003; 20 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG3-2650; No Copyright; Avail: CASI; A03, Hardcopy

This report presents a critical review of the processing techniques for fabricating continuous fiber-reinforced CMCs for possible applications at elevated temperatures. Some of the issues affecting durability of the composite materials such as fiber coatings and cracking of the matrix because of shrinkage in PIP-process are also examined. An assessment of the potential inexpensive processes is also provided. Finally three potential routes of manufacturing C/SiC composites using a technology that NC A&T developed for carbon/carbon composites are outlined. Challenges that will be encountered are also listed.
Author
Carbon Fibers; Carbon-Carbon Composites; Ceramic Matrix Composites; Fabrication; High Temperature; Propulsion

20030020864 Old Dominion Univ., Norfolk, VA, USA
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials
Prabhakaran, R.; March 12, 2003; 22 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG8-1813; ODURF Proj. 113381; No Copyright; Avail: CASI; A03, Hardcopy

The project included three lines of investigation, aimed at a better understanding of the damage resistance and damage tolerance of pultruded composites. The three lines of investigation were: (i) measurement of permanent dent depth after transverse indentation at different load levels, and correlation with other damage parameters such as damage area (from x-radiography) and back surface crack length, (ii) estimation of point stress and average stress characteristic dimensions corresponding to measured damage parameters, and (iii) an attempt to measure the damage area by a reflection photoelastic technique. All the three lines of investigation were pursued.
Author
Damage; Composite Materials; Pultrusion; Indentation; Loads (Forces); Stresses; Surface Cracks

20030020936 NASA Glenn Research Center, Cleveland, OH, USA
Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites
Abdalla, Mohamed O.; Dean, Derrick; Campbell, Sandi; Polymer; January 2002; ISSN 0032-3861; 6808, pp. 1-7; In English
Contract(s)/Grant(s): NAG3-2432; RTOP 708-31-13; Copyright; Avail: CASI; A02, Hardcopy

High temperature thermoset polyimide-clay nanocomposites were prepared by blending 2.5 and 5 wt% of an unmodified Na(+-) montmorillonite (PGV) and two organically modified FGV (PGVCl0COOH, PGVC12) with a methanol solution of PMR-15 precursor. The methanol facilitated the dispersal of the unmodified clay. Dynamic mechanical analysis results showed a significant increase in the thermomechanical properties (E' and E') of 2.5 wt% clay loaded nanocomposites in comparison with the neat polyimide. Higher glass transition temperatures were observed for 2.5 wt% nanocomposites compared to the neat polyimide. Flexural properties measurements for the 2.5 wt% nanocomposites showed a significant improvement in the modulus and strength, with no loss in elongation. This trend was not observed for the 5 wt% nanocomposites. An improvement in the CTE was observed for the PGV/PMR-15 nanocomposites, while a decrease was observed for the organically modified samples. This was attributed to potential variations in the interface caused by modifier degradation.
Author
Nanocomposites; Silicates; Viscoelasticity; Mechanical Properties; Polyimides; Thermodynamics

20030020944 NASA Glenn Research Center, Cleveland, OH, USA

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite

Kalluri, Sreeramesh; Verrilli, Michael J.; January 2003; 8 pp.; In English; 27th Annual Cocoa Beach Conference & Exposition on Advanced Ceramics & Composites, 26 Jan. 2003, Cocoa Beach, FL, USA

Contract(s)/Grant(s): NAG3-2587; RTOP 714-04-19; No Copyright; Avail: CASI; A02, Hardcopy

Effects of different sizes of holes as well as different percentages of open areas on the in-plane tensile strength and fatigue durability of the SiC/Si-N-C composite were investigated in this study. Test specimens with no holes, four different diameters of holes (1.0 to 3.2 mm), and four different open areas (20 to 35\%) were machined. All mechanical testing was performed in air at a temperature of 910 C. Fatigue tests were conducted with a load ratio, R = 0.05, and a frequency of 0.33 Hz. In general, both the in-plane tensile strength of the composite and its fatigue durability decreased with an increase in the size of the hole and percentage of the open area. Reductions in the in-plane tensile strength and cyclic fatigue life of the composite were described by empirical equations with the diameter of the hole and the percent open area as the independent variables. The validity of these two empirical equations was verified with additional tensile and fatigue test data generated on the composite specimens.

Author

Ceramic Matrix Composites; Fatigue Life; Fatigue Tests; Tensile Strength; Holes (Mechanics); Silicon Nitrides; Silicon Carbides

20030020948 NASA Kennedy Space Center, Cocoa Beach, FL, USA

Cryogenic Information Center

Mohling, Robert A.; Marquardt, Eric D.; Fusilier, Fred C.; Fesmire, James E.; January 2003; 6 pp.; In English; 21st International Congress of Refrigeration, 17-22 Aug. 2003, Washington, DC, USA

Report No.(s): KSC-2003-027; ICR0633; Copyright; Avail: CASI; A02, Hardcopy

The Cryogenic Information Center (CIC) is a not-for-profit corporation dedicated to preserving and distributing cryogenic information to government, industry, and academia. The heart of the CIC is a uniform source of cryogenic data including analyses, design, materials and processes, and test information traceable back to the Cryogenic Data Center of the former National Bureau of Standards. The electronic database is a national treasure containing over 146,000 specific bibliographic citations of cryogenic literature and thermophysical property data dating back to 1829. A new technical/bibliographic inquiry service can perform searches and technical analyses. The Cryogenic Material Properties (CMP) Program consists of computer codes using empirical equations to determine thermophysical material properties with emphasis on the 4-300K range. CMP's objective is to develop a user-friendly standard material property database using the best available data so government and industry can conduct more accurate analyses. The CIC serves to benefit researchers, engineers, and technologists in cryogenics and cryogenic engineering, whether they are new or experienced in the field.

Author

Cryogenics; Thermophysical Properties; Information Retrieval; Mechanical Properties

20030022658 Missouri Univ., Rolla, MO, USA

Isocyanate Cross-Linked Silica: Structurally Strong Aerogels

Leventis, Nicholas; Sotiriou-Leventis, Chariklia; Zhang, Guo-Hui; Rawashdeh, Abdel-Monem M.; [2002]; 2 pp.; In English; 225th National American Chemical Society Meeting, 23-27 Mar. 2003, New Orleans, LA, USA

Contract(s)/Grant(s): ACS-35154-AC5; WBS 22-708-92-05; RTOP 708-93-06; Copyright; Avail: CASI; A01, Hardcopy

Molecular-level synergism between the silica nanoparticles of pre-formed monoliths and molecular cross-linkers inverts the relative host-guest roles in glass-polymer composites, leading to new strong low-density materials. Attempts to load gels with variable amounts of polyurethane precursors such as di-ISO and diol end-capped polybutylene adipate followed by heat treatment, washing, and supercritical drying led to opaque materials, somewhat stronger than silica but still quite brittle and much inferior to the materials described above. Direct mixing of a diisocyanate and an alcohol-free sol has been attempted recently by Yim et al. Reportedly, that procedure leads to week-long gelation times and requires an at least equally long aging period. In our attempt to add various amounts of di-ISO in a base-catalyzed sol in PC, we also noticed a week-long gelation time. The resulting aerogels were translucent but no less brittle than native silica. According to more recent studies, if propylene carbonate is replaced with acetone, it leads not only to shorter processing times, but also to much stronger gels that can tolerate loads in excess of 40 kg in the arrangement presented. We attribute that behavior to the lower viscosity of acetone, that allows faster diffusion of the di-ISO solution within the pores before di-ISO has time to react with the surface of silica.

Further studies are underway to vary the chemical identity of the diisocyanate, as well as the composition and density of silica. Derived from text

Isocyanates; Silicon Dioxide; Aerogels; Nanoparticles; Crosslinking

20030022679 NASA Glenn Research Center, Cleveland, OH, USA

Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites

Morscher, Gregory N.; Yun, Hee Mann; DiCarlo, James A.; Thomas-Ogbuji, Linus; [2002]; 30 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): RTOP 714-04-30

Report No.(s): E-13675; Copyright; Avail: CASI; A03, Hardcopy

Typically, the debonding and sliding interface enabling fiber pullout for silicon-carbide fiber-reinforced silicon-carbide matrix composites with BN-based interphases occurs between the fiber and the interphase. Recently, composites have been fabricated where interface debonding and sliding occurs between the BN interphase and the matrix. This results in two major improvements in mechanical properties. First, significantly higher failure strains were attained due to the lower interfacial shear strength with no real loss in ultimate strength properties of the composites. Second, significantly longer stress-rupture times at higher stresses were observed in air at 815 C. In addition, no real loss in mechanical properties was observed for composites that did not possess a thin carbon layer between the fiber and the interphase when subjected to burner-rig exposure. Outside debonding is hypothesized to be due to two primary factors: a weaker interface at the BN/matrix interface than the fiber BN interface and a residual tensile/shear stress-state at the interface of melt-infiltrated composites. Also, the occurrence of outside debonding was believed to occur during composite fabrication, i.e., on cool down after molten silicon infiltration. Author

Boron Nitrides; Debonding (Materials); Silicon Carbides; Mechanical Properties; Fabrication; Ceramic Matrix Composites

20030022738 NASA Glenn Research Center, Cleveland, OH, USA

Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data

Bowles, Kenneth J.; Tsuji, Luis; Kamvouris, John; Roberts, Gary D.; February 2003; 64 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): WBS?22?708?31?13

Report No.(s): NASA/TM-2003-211870; NAS 1.15:211870; E-13552; No Copyright; Avail: CASI; A04, Hardcopy

A cooperative program was conducted with the General Electric Aircraft Engines plant in Evendale, Ohio, to study the effects of long-term isothermal aging at elevated temperatures on compression and thermal durability properties of T650 35 fabric-reinforced PMR 15 composites. This degradation study was conducted over an approximate time period of 3 1/2 yr. The aging temperatures were 204, 260, 288, 316, and 343 C. Specimens of different dimensions were evaluated. Specimens with ratios of the cut edge to total surface area of 0.03 to 0.89 were fabricated and aged. The aged and unaged specimens were tested in compression as specified in Test Method for Compressive Properties of Rigid Plastics (ASTM D695M). Thickness changes, degraded surface layer growth, weight loss, and failure modes were monitored and recorded. All property changes were thickness dependent.

Author

Aging (Materials); Isothermal Processes; Fabrication; Mechanical Properties; Polyimides; Structural Weight; Compressibility; Composite Materials

20030022779 NASA Glenn Research Center, Cleveland, OH, USA

K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far

Miranda, Felix A.; Romanofsky, Robert; Mueller, Carl H.; VanKeuls, Fred; November 29, 2002; 36 pp.; In English; 2002 Fall MRS Meeting, 3 Dec. 2002, Boston, MA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 22-755-08-02; No Copyright; Avail: CASI; A03, Hardcopy

The Applied RF Technology Branch of the NASA Glenn Research Center, Cleveland, Ohio, has an on-going effort in the area of thin film ferroelectric technology for microwave applications. Particular attention has been given to developing ferroelectric phase shifters for the implementation and experimental demonstration of an electronically steerable reflectarray antenna. In the process of optimizing these material to fit the implementation requirements of the aforementioned antenna, we have accumulated a great deal of information and knowledge in areas such as the effect of the composition of the ferroelectric thin films on phase shifter performance, self assembled monolayers (SAMs) in the metallic/ferroelectric interface and their

impact on phase shifter performance, correlation between microstructure and microwave properties, and the effect of selective etching on the overall performance of a thin film-ferroelectric based microwave component, amongst others. We will discuss these issues and will provide an up-dade of the current development status of the reflect-array antenna.
Author
Antenna Arrays; Microwave Antennas; Ferroelectricity

20030025252 NASA Glenn Research Center, Cleveland, OH, USA
Nanostructured Materials Development for Space Power
Raffaelle, Ryne P.; Landi, B. J.; Elich, J. B.; Gennett, T.; Castro, S. L.; Bailey, Sheila G.; Hepp, Aloysius F.; January 2003; 6 pp.; In English; AIAA Sciences Meeting, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations
Contract(s)/Grant(s): 755-60-03; Copyright; Avail: CASI; A02, Hardcopy

There have been many recent advances in the use of nanostructured materials for space power applications. In particular, the use of high purity single wall nanotubes holds promise for a variety of generation and storage devices including: thin film lithium ion batteries, microelectronic proton exchange membrane (PEM) fuel cells, polymeric thin film solar cells, and thermionic power supplies is presented. Semiconducting quantum dots alone and in conjunction with carbon nanotubes are also being investigated for possible use in high efficiency photovoltaic solar cells. This paper will review some of the work being done at RIT in conjunction with the NASA Glenn Research Center to utilize nanomaterials in space power devices.
Author
Technology Utilization; Quantum Dots; Purity; Metal Ions; Product Development

20030025301 NASA Glenn Research Center, Cleveland, OH, USA
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C
Williams, W. D., Technical Monitor; Ponchak, G. E.; Schwartz, Z.; Alterovitz, S. A.; Downey, A. N.; Freeman, J. C.; [2003]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

For the first time, the temperature and frequency dependence of the attenuation of a Coplanar Waveguide (CPW) on 4H, High Resistivity Sic substrate is reported. The low frequency attenuation increases by 2 dB/cm at 500 C and the high frequency attenuation increases by 3.3 dB/cm at 500 C compared to room temperature.
Author
Temperature Dependence; Waveguides; Silicon Oxides; Electrical Resistivity

20030025366 NASA Langley Research Center, Hampton, VA, USA
Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems
Gates, Thomas S.; Hinkley, Jeffrey A.; March 2003; 20 pp.; In English
Contract(s)/Grant(s): RTOP 706-63-51-03
Report No.(s): NASA/TM-2003-212163; L-18267; NAS 1.15:212163; No Copyright; Avail: CASI; A03, Hardcopy

The paper provides details on the structure and implementation of the Computational Materials program at the NASA Langley Research Center. Examples are given that illustrate the suggested approaches to predicting the behavior and influencing the design of nanostructured materials such as high-performance polymers, composites, and nanotube-reinforced polymers. Primary simulation and measurement methods applicable to multi-scale modeling are outlined. Key challenges including verification and validation of models are highlighted and discussed within the context of NASA's broad mission objectives.
Author
Nanotechnology; Nanocomposites; Polymer Matrix Composites; Computerized Simulation; Multiscale Models

20030032203 NASA Glenn Research Center, Cleveland, OH, USA
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites
Gaier, James R.; Vandenburg, Yvonne Yoder; Berkebile, Steven; Stueben, Heather; Balagadde, Frederick; [2002]; 10 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC3-317; RTOP 755-A4-06
Report No.(s): E-13679; Copyright; Avail: CASI; A02, Hardcopy

A series of woven fabric laminar composite plates and narrow strips were fabricated from a variety of pitch-based pristine and bromine intercalated graphite fibers in an attempt to determine the influence of the weave on the electrical and thermal conduction. It was found generally that these materials can be treated as if they are homogeneous plates. The rule of mixtures

describes the resistivity of the composite fairly well if it is realized that only the component of the fibers normal to the equipotential surface will conduct current. When the composite is narrow with respect to the fiber weave, however, there is a marked angular dependence of the resistance which was well modeled by assuming that the current follows only along the fibers (and not across them in a transverse direction), and that the contact resistance among the fibers in the composite is negligible. The thermal conductivity of composites made from less conductive fibers more closely followed the rule of mixtures than that of the high conductivity fibers, though this is thought to be an artifact of the measurement technique. Electrical and thermal anisotropy could be induced in a particular region of the structure by weaving together high and low conductivity fibers in different directions, though this must be done throughout all of the layers of the structure as interlaminar conduction precludes having only the top layer carry the anisotropy. The anisotropy in the thermal conductivity is considerably less than either that predicted by the rule of mixtures or the electrical resistivity.
Author
Plates (Structural Members); Thermal Conductivity; Woven Composites; Electrical Resistivity; Intercalation; Graphite-Epoxy Composites; Carbon Fiber Reinforced Plastics

25
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

20030020927 NASA Glenn Research Center, Cleveland, OH, USA
Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite
Verrilli, Michael J.; Calomino, Anthony; November 07, 2002; 7 pp.; In English; 27th Annual International Conference on Advanced Ceramics and Composites, 26-31 Jan. 2003, Cocoa Beach, FL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS: 22-708-73-13; No Copyright; Avail: CASI; A02, Hardcopy

Tensile strengths and stress rupture lives of carbon-fiber reinforced silicon carbide (C/SiC) specimens were measured at 800 C and are compared to previously reported 1200 C data. All tests were conducted in an environmental chamber containing 1000 ppm of oxygen in argon. The average 800 C tensile strength of 610 MPa is 10\% greater than at 1200 C. Average stress rupture lives at 800 C were 2.5 times longer than those obtained at 1200 C. The difference in the 800 and 1200 C lives is related to the oxidation rate of the reinforcing carbon fibers, which is the primary damage mode of C/SiC composites in oxygen-containing environments.
Author
Tensile Stress; Temperature Dependence; Tensile Strength; Rupturing; Fiber Composites; Carbon Fibers; Silicon Carbides

20030020935 NASA Glenn Research Center, Cleveland, OH, USA
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors
Castro, Stephanie L.; Bailey, Sheila G.; Raffaelle, Ryne P.; Banger, Kulbinder K.; Hepp, Aloysius F.; November 11, 2002; 3 pp.; In English; 3rd World Conference on Photovoltaic Energy Conversion, 11-18 May 2003, Osaka, Japan
Contract(s)/Grant(s): RTOP 755-60-03; Copyright; Avail: CASI; A01, Hardcopy

Single-source precursors are molecules which contain all the necessary elements for synthesis of a desired material. Thermal decomposition of the precursor results in the formation of the material with the correct stoichiometry, as a nanocrystalline powder or a thin film. Nanocrystalline materials hold potential as components of next-generation Photovoltaic (PV) devices. Presented here are the syntheses of CuInS2 and CuInSe2 nanocrystals from the precursors (PPh3)2CuIn(SEt)4 and (PPh3)2CuIn(SePh)4, respectively. The size of the nanocrystals varies with the reaction temperature; a minimum of 200 C is required for the formation of the smallest CuInS2 crystals (approximately 1.6 nm diameter); at 300 C, crystals are approximately 7 nm.
Author
Copper Indium Selenides; Synthesis (Chemistry); Nanocrystals; Low Temperature; Pyrolysis; Indium Sulfides; Photovoltaic Conversion; Thin Films

20030022660 NASA Glenn Research Center, Cleveland, OH, USA

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex.

Banger, Kulbinder K.; Duraj, Stan A.; Fanwic, Phillp E.; Hepp, Aloysius F.; Martuch, Robert A.; January 2003; 12 pp.; In English

Contract(s)/Grant(s): NCC3-318; NCC3-162; NCC3-246; RTOP 755-60-01; No Copyright; Avail: CASI; A03, Hardcopy

The synthesis and structural characterization of a novel ionic Ga(III) five coordinate complex [{CH3(C5H4N)}Ga(SCH2(CO)O)2]-[(4-MepyH)]+, (4-Mepy = CH3(C5H5N)) from the reaction between Ga2Cl4 with sodium mercapto-acetic acid in 4-methylpyridine is described. Under basic reaction conditions the mercapto ligand is found to behave as a 2e- bidentate ligand. Single crystal X-ray diffraction studies show the complex to have a distorted square pyramidal geometry with the [(-SCH2(CO)CO-)] ligands in a trans conformation. The compound crystallizes in the P2(sub 1)/c (No. 14) space group with a = 7.7413(6) A, b = 16.744(2) A, c = 14.459(2) A, V = 1987.1(6) A(sup 3), R(F) = 0.032 and R(sub w) = 0.038.

Author

Acetic Acid; Sodium; Thiols; Synthesis (Chemistry); Ions; Chemical Reactions

20030025402 NASA Glenn Research Center, Cleveland, OH, USA National Center for Microgravity Research on Fluids and Combusiton, Cleveland, OH, USA

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images

VanderWal, Randy L.; Tomasek, Aaron J.; Street, Kenneth; Thompson, William K.; November 02, 2002; 22 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NRA-99-HEDs-01; NCC3-975; WBS 22-101-12-15; No Copyright; Avail: CASI; A03, Hardcopy

The dimensions of graphitic layer planes directly affect the reactivity of soot towards oxidation and growth. Quantification of graphitic structure could be used to develop and test correlations between the soot nanostructure and its reactivity. Based upon transmission electron microscopy images, this paper provides a demonstration of the robustness of a fringe image analysis code for determining the level of graphitic structure within nanoscale carbon, i.e. soot. Results, in the form of histograms of graphitic layer plane lengths, are compared to their determination through Raman analysis.

Author

Carbon; High Resolution; Nanostructure (Characteristics); Transmission Electron Microscopy; Image Analysis; Raman Spectroscopy

20030032235 NASA Glenn Research Center, Cleveland, OH, USA

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces

Neudeck, Philip G.; Powell, J. Anthony; Trunek, Andrew; Spry, David; Beheim, Glenn M.; Benavage, Emye; Abel, Phillip; Vetter, William M.; Dudley, Michael, Trans ; Materials Science Forum; 2002; Volumes 389-393, pp. 251-254; In English; International Conference on Silicon Carbide and Related Materials 2001, 28 Oct. - 2 Nov. 2001, Tsukuba, Japan; Original contains black and white illustrations; Copyright; Avail: Other Sources

Homoepitaxial Chemical Vapor Deposition (CVD) growth of thin lateral cantilevers emanating from the edges of mesa patterns dry-etched into on-axis commercial 4H-SiC substrates prior to growth is reported. Cantilevers on the order of a micrometer thick extending tens of micrometers from the edge of a mesa have been grown. The termination of vertically propagating screw dislocations, including a micropipe, that are overgrown by the cantilevers has been demonstrated, in large part because the crystal structure of the cantilevers is established laterally from the mesa sidewalls. This technique could help reduce performance-degrading dislocations in SiC electrical devices.

Author

Silicon Carbides; Epitaxy; Vapor Deposition; Crystal Growth

26
METALS AND METALLIC MATERIALS

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

20030021308 NASA Glenn Research Center, Cleveland, OH, USA Ohio Aerospace Inst., Cleveland, OH, USA
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy
Demarco, Gustavo; Garces, Jorge E.; Bozzolo, Guillermo; [2002]; 36 pp.; In English
Contract(s)/Grant(s): NCC3-594; RTOP 708-31-02
Report No.(s): E-13821; Copyright; Avail: CASI; A03, Hardcopy

The Bozzolo, Ferrante, and Smith (BFS) method for alloys is applied to the study of Pt deposition on Cu(100). The formation of a Cu-Pt surface alloy is discussed within the framework of previous results for Pd/Cu(100). In spite of the fact that both Pd and Pt share the same basic behavior when deposited on Cu, it is seen that subtle differences become responsible for the differences in growth observed at higher cover-ages. In agreement with experiment, all the main features of Pt/Cu(100) and Pd/Cu(100) are obtained by means of a simple modeling scheme, and explained in terms of a few basic ingredients that emerge from the BFS analysis.
Author
Platinum; Palladium; Crystal Growth; Copper; Adatoms; Mathematical Models; Alloys; Computerized Simulation; Surface Properties; Metal Surfaces

20030022686 NASA Glenn Research Center, Cleveland, OH, USA
Site Occupancy of Ternary Additions to B2 Alloys
Bozzolo, Guillermo H.; Noebe, Ronald D.; Amador, Carlos, Elsevi; Intermetallics; January 2002; ISSN 0966-9795; Volume 10, pp. 149-159; In English
Report No.(s): RTOP 708-31-13; Copyright; Avail: Other Sources

In this broad-based survey study, the substitutional site preference of ternary alloying additions to B2 compounds (stable at room temperature and 50/50 composition) is determined using the Bozzolo-Ferrante-Smith (BFS) method for alloys. The method is applied to Ni, Al, Ti, Cr, Cu, Co, Fe, Ta, Hf, Mo, Nb, W, V and Ru additions to NiAl, FeAl, CoAl, CoFe, CoHf, CoTi, FeTi, RuAl, RuSi, RuHf, RuTi, and RuZr. The results are compared, when available, to experimental data and other theoretical results.
Author
Ternary Alloys; Nickel Aluminides; Boron Alloys; Intermetallics; Computerized Simulation

20030022720 NASA Glenn Research Center, Cleveland, OH, USA
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks
Gayda, John; Gabb, Tim; Kantzos, Pete; Furrer, David; [2003]; 18 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

There are numerous incidents where operating conditions imposed on a component mandate different and distinct mechanical property requirements from location to location within the component. Examples include a crankshaft in an internal combustion engine, gears for an automotive transmission, and disks for a gas turbine engine. Gas turbine disks are often made from nickel-base superalloys, because these disks need to withstand the temperature and stresses involved in the gas turbine cycle. In the bore of the disk where the operating temperature is somewhat lower, the limiting material properties are often tensile and fatigue strength. In the rim of the disk, where the operating temperatures are higher than those of the bore, because of the proximity to the combustion gases, resistance to creep and crack growth are often the limiting properties.
Derived from text
Low Cost; Heat Treatment; Tensile Strength; Nickel Alloys; Microstructure; Heat Resistant Alloys; Crack Propagation; Combustion Products

20030025290 NASA Glenn Research Center, Cleveland, OH, USA
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy
Raj, S. V.; Ghosn, L. J.; Agarwal, A.; Lachtrupp, T. P.; [2002]; 8 pp.; In English; Symposium on Surface Engineering: In Material Science II, 2-6 Mar. 2003, San Diego, CA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 22-708-73-04; Copyright; Avail: CASI; A02, Hardcopy

Modeling studies were conducted on low pressure plasma sprayed (LPPS) NiAl top coat applied to an advanced

Cu-8(at.%)Cr-4\%Nb alloy (GRCop-84) substrate using Ni as a bond coat. A thermal analysis suggested that the NiAl and Ni top and bond coats, respectively, would provide adequate thermal protection to the GRCop-84 substrate in a rocket engine operating under high heat flux conditions. Residual stress measurements were conducted at different depths from the free surface on coated and uncoated GRCop-84 specimens by x-ray diffraction. These data are compared with theoretically estimated values assessed by a finite element analysis simulating the development of these stresses as the coated substrate cools down from the plasma spraying temperature to room temperature.
Author
Stress Measurement; Residual Stress; Low Pressure; Plasma Spraying; Coatings; Copper Alloys; Models

20030025295 NASA Glenn Research Center, Cleveland, OH, USA
Alumina Volatility in Water Vapor at Elevated Temperatures
Opila, Elizabeth J.; Myers, Dwight L.; [2003]; 15 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 22-896-50-01
Report No.(s): E-13870; No Copyright; Avail: CASI; A03, Hardcopy

The volatility of alumina in high temperature water vapor was determined by a weight loss technique. Sapphire coupons were exposed at temperatures between 1250 and 1500 C, water partial pressures between 0.15 and 0.68 atm in oxygen, total pressure of 1 atm, and flowing gas velocities of 4.4 cm/s. The pressure dependence of sapphire volatility was consistent with AI(OH)3(g) formation. The enthalpy of reaction to form Al(OH)3(g) from sapphire and water vapor was determined to be 210 +/- 20 kJ/mol, comparing favorably to other studies. Microstructural examination of tested sapphire coupons revealed surface etching features consistent with a volatilization process.
Author
Aluminum Oxides; Acidity; Volatility; Vaporizing; Water Vapor; High Temperature

20030025385 Pennsylvania State Univ., University Park, PA, USA
Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718
Iyer, Saiganesh K.; Lissenden, Cliff J.; September 23, 2002; 17 pp.; In English
Contract(s)/Grant(s): NCC3-597; Copyright; Avail: CASI; A03, Hardcopy

The nickel-base alloy Inconel 718 exhibits a strength-differential, that is, a different plastic flow behavior in uniaxial tension and uniaxial compression. A phenomenological viscoplastic model founded on thermodynamics has been extended for material behavior that deviates from classical metal plasticity by including all three stress invariants in the threshold function. The model can predict plastic flow in isotropic materials with or without a flow stress asymmetry as well as with or without pressure dependence. Viscoplastic material parameters have been fit to pure shear, uniaxial tension, and uniaxial compression experimental results at 650 C. Threshold function material parameters have been fit to the strength-differential. Four classes of threshold functions have been considered and nonproportional loading of hollow tubes, such as shear strain followed by axial strain, has been used to select the most applicable class of threshold function and validate the multiaxial model. A J2J3 class model, where J2 and J3 are the second and third effective deviatoric stress invariants, was found to agree the best with the experimental results.
Author
Heat Resistant Alloys; Inconel (Trademark); Mathematical Models; Nickel Alloys; Mechanical Properties; Axial Strain; Viscoplasticity

20030025436 NASA Glenn Research Center, Cleveland, OH, USA
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy
Wilson, A.; Bozzolo, G.; Noebe, R. D.; Howe, J. M., Elsevi; Acta Materialia; June 01, 2002; Volume 50, pp. 2787-2800; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NGT3-52315; RTOP 708-31-13
Report No.(s): E-13643; Copyright; Avail: Other Sources

The Bozzolo-Ferrante-Smith (BFS) method for alloys was applied to the study of NiAl-based materials to assess the effect of alloying additions on structure. Ternary, quaternary and even pentalloys based on NiAl with additions of Ti, Cr and Cu were studied and experimental verification of the theoretical predictions including the phase structure of a Ni-Al-Ti-Cr-Cu alloy is presented. Two approaches were used, Monte Carlo simulations to determine low energy structures, and analytical calculations of the energy of high symmetry configurations which give physical insight into preferred structures. The energetics for site occupancy in ternary and quaternary systems were calculated leading to an indirect determination of solubility limits at 0 K.

Precipitate formation with information concerning structure and lattice parameter were also 'observed' computationally and the general characteristics of a Ni-Al-Ti-Cr-Cu alloy were correctly predicted. The results indicate that the BFS method for alloys can be a useful tool for alloy design and can be used to complement experimental alloy design programs.
Author
Experiment Design; Numerical Analysis; Phase Transformations; Phase Stability (Materials); Lattice Parameters; Proving

20030025734 NASA Glenn Research Center, Cleveland, OH, USA
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature
Colaiuta, J. F.; Lissenden, C. J.; Lerch, B. A.; January 2003; 8 pp.; In English; Proceedings of the Sixth International Conference on Biaxial/Multiaxial Fatigue and Fracture, 25-28 Jun. 2001, Lisboa, Portugal; Original poor quality
Contract(s)/Grant(s): NCC3-597; RTOP 708-31-13; No Copyright; Avail: CASI; A02, Hardcopy

Type 316 stainless steel, Haynes 188, and Inconel 718 samples were subjected to an axial-shear strain controlled loading history while the specimen temperature was held at 650 C to quantify the evolution of material state under a complex biaxial load path when the material is in the viscoplastic domain. Yield surfaces were constructed in the axial-shear stress plane using a sensitive, 30 x 10(exp -6)m/m, equivalent offset strain definition for the yield strain. Subsequent yield surfaces were constructed at various points along the strain path to define the material evolution. These subsequent yield surface translated, expanded, and distorted relative to the initial yield surface. Each of these very different materials exhibited components of isotropic, kinematic and distortional hardening. Furthermore, subsequent yield surfaces for each material have a very well defined front face and a poorly defined, flattened, back side.
Author
Alloys; Shear Stress; High Temperature; Viscoplasticity

20030025752 NASA Glenn Research Center, Cleveland, OH, USA
Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys
Bozzolo, Guillermo H.; Khalil, Joseph; Noebe, Ronald D., Elsevi; Computational Materials Science; [2002]; ISSN 0927-0256; Volume 24, pp. 457-480; In English; Copyright; Avail: Other Sources

The underlying equilibrium structure, site substitution behavior, and lattice parameter of ternary Ni-Fe-Al alloys are determined via Monte Carlo-Metropolis computer simulations and analytical calculations using the BFS method for alloys for the energetics. As a result of the theoretical calculations presented, a simple approach based on the energetics of small atomic clusters is introduced to explain the observed site preference schemes.
Author
Aluminum Alloys; Nickel Compounds; Iron Compounds; Computerized Simulation

20030031352 NASA Glenn Research Center, Cleveland, OH, USA
Mechanical Properties of a Superalloy Disk With a Dual Grain Structure
Gayda, John; Gabb, Timothy; Kantzos, Peter; March 2003; 19 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): WBS-22-708-31-04
Report No.(s): NASA/TM-2003-212181; NAS 1.15:212181; E-13782; No Copyright; Avail: CASI; A03, Hardcopy

Mechanical properties from an advanced, nickel-base superalloy disk, with a dual grain structure consisting of a fine grain bore and coarse grain rim, were evaluated. The dual grain structure was produced using NASA's low cost Dual Microstructure Heat Treatment (DMHT) process. The results showed the DMHT disk to have a high strength, fatigue resistant bore comparable to a subsolvus (fine grain) heat treated disk, and a creep resistant rim comparable to a supersolvus (coarse grain) heat treated disk. Additional work on subsolvus solutioning before or after the DMHT conversion appears to be a viable avenue for further improvement in disk properties.
Author
Mechanical Properties; Heat Resistant Alloys; Granular Materials; Microstructure; Heat Treatment; Nickel Alloys; Powder Metallurgy

20030032199 NASA Glenn Research Center, Cleveland, OH, USA Arizona Univ., Tucson, AZ, USA Cleveland State Univ., Cleveland, OH, USA
Directional Solidification and Convection in Small Diameter Crucibles
Chen, J.; Sung, P. K.; Tewari, S. N.; Poirier, D. R.; DeGroh, H. C., III; [2003]; 24 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC3-818; WBS 22-101-58-07
Report No.(s): E-13814; Copyright; Avail: CASI; A03, Hardcopy

Pb-2.2 wt% Sb alloy was directionally solidified in 1, 2, 3 and 7 mm diameter crucibles. Pb-Sb alloy presents a solutally unstable case. Under plane-front conditions, the resulting macrosegregation along the solidified length indicates that convection persists even in the 1 mm diameter crucible. Al-2 wt% Cu alloy was directionally solidified because this alloy was expected to be stable with respect to convection. Nevertheless, the resulting macrosegregation pattern and the microstructure in solidified examples indicated the presence of convection. Simulations performed for both alloys show that convection persists for crucibles as small as 0.6 mm of diameter. For the solutally stable alloy, Al-2 wt% Cu, the simulations indicate that the convection arises from a lateral temperature gradient.
Author
Convection; Crucibles; Directional Solidification (Crystals); Lead Alloys; Tin Alloys; Alloying

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*.

20030022688 NASA Glenn Research Center, Cleveland, OH, USA
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach
Zhu, Dongming; Miller, Robert A.; January 2003; 22 pp.; In English; 27th Annual International Conference on Advanced Ceramics and Composites, 26-31 Jan. 2003, Cocoa Beach, FL, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The development of low conductivity, robust thermal and environmental barrier coatings requires advanced testing techniques that can accurately and effectively evaluate coating thermal conductivity and cyclic resistance at very high surface temperatures (up to 1700 C) under large thermal gradients. In this study, a laser high-heat-flux test approach is established for evaluating advanced low conductivity, high temperature capability thermal and environmental barrier coatings under the NASA Ultra Efficient Engine Technology (UEET) program. The test approach emphasizes the real-time monitoring and assessment of the coating thermal conductivity, which initially rises under the steady-state high temperature thermal gradient test due to coating sintering, and later drops under the cyclic thermal gradient test due to coating cracking/delamination. The coating system is then evaluated based on damage accumulation and failure after the combined steady-state and cyclic thermal gradient tests. The lattice and radiation thermal conductivity of advanced ceramic coatings can also be evaluated using laser heat-flux techniques. The external radiation resistance of the coating is assessed based on the measured specimen temperature response under a laser- heated intense radiation-flux source. The coating internal radiation contribution is investigated based on the measured apparent coating conductivity increases with the coating surface test temperature under large thermal gradient test conditions. Since an increased radiation contribution is observed at these very high surface test temperatures, by varying the laser heat-flux and coating average test temperature, the complex relation between the lattice and radiation conductivity as a function of surface and interface test temperature may be derived.
Author
Thermal Control Coatings; High Temperature Tests; Ceramic Coatings; Laser Heating

20030032188 NASA Langley Research Center, Hampton, VA, USA
Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures
Whitley, Karen S.; Gates, Thomas S.; March 2003; 32 pp.; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Apr. 2002, Denver, CO, USA; Original contains black and white illustrations
Contract(s)/Grant(s): 721-21-10-01
Report No.(s): NASA/TM-2003-212171; L-18269; NAS 1.15:212171; No Copyright; Avail: CASI; A03, Hardcopy

In order for polymeric-matrix composites to be considered for use as structural materials in the next generation of space transportation systems, the mechanical behavior of these materials at cryogenic temperatures must be investigated. This paper presents experimental data on the residual mechanical properties of a carbon-fiber polymeric composite, IM7/PETI-5, both before and after aging. Both tension and compression modulus and strength were measured at room temperature, -196C, and -269 C on five different laminate configurations. One set of specimens was aged isothermally for 576 hours at -184 C in an unconstrained state. Another set of corresponding specimens was aged under constant uniaxial strain for 576 hours at -184 C. Based on the experimental data presented, it is shown that trends in stiffness and strength that result from changes in temperature are not always smooth and consistent. Moreover, it is shown that loading mode and direction are significant for

both stiffness and strength, and aging at cryogenic temperature while under load can alter the mechanical properties of pristine, un-aged laminates made of IM7/PETI-5 material.
Author
Temperature Effects; Polymer Matrix Composites; Cryogenic Temperature; Compressive Strength

20030032245 NASA Glenn Research Center, Cleveland, OH, USA
A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications
Freed, Alan; Leonov, Arkady I.; Journal of the Mechanics and Physics of Solids; July 03, 2002, pp. 1-17; In English
Contract(s)/Grant(s): NCC3-752
Report No.(s): Rept-3/PT3; No Copyright; Avail: CASI; A03, Hardcopy

This paper, the last in the series, continues developing the nonlinear constitutive relations for non-isothermal, compressible, solid viscoelasticity. We initially discuss a single integral approach, more suitable for the glassy state of rubber-like materials, with basic functionals involved in the thermodynamic description for this type of viscoelasticity. Then we switch our attention to analyzing stability constraints, imposed on the general formulation of the nonlinear theory of solid viscoelasticity. Finally, we discuss specific (known from the literature or new) expressions for material functions that are involved in the constitutive formulations of both the rubber-like and glassy-like, complementary parts of the theory.
Author
Nonlinearity; Thermodynamics; Viscoelasticity; Solids; Nonequilibrium Thermodynamics; Glass; Stability

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*.

20030031357 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants
Cardiff, Eric H.; [2003]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

When an acoustic wave is present in a solid propellant combustion environment, the mass flux from the combustion zone oscillates at the same frequency as the acoustics. The acoustic wave is either amplified or attenuated by the response of the combustion to the acoustic disturbance. When the acoustic wave is amplified, this process is called combustion instability. The amplification is quantitatively measured by a response function. The ability to predict combustion stability for a solid propellant formulation is essential to the formulator to prevent or minimize the effects of instabilities, such as an oscillatory thrust. Unfortunately, the prediction of response values for a particular propellant remains a technical challenge. Most predictions of the response of propellants are based on test data, but there are a number of questions about the reliability of the standard test method, the T-burner. Alternate methods have been developed to measure the response of a propellant, including the ultrasound burner, the magnetic flowmeter and the rotating valve burner, but there are still inconsistencies between the results obtained by these different methods. Aside from the experimental differences, the values of the pressure-coupled responses obtained by different researchers are often compared erroneously, for the simple reason that inconsistencies in the definitions of the responses and admittances are not considered. The use of different definitions has led to substantial confusion since the first theoretical treatments of the problem by Hart and McClure in 1959. The definitions and relations derived here seek to alleviate this problem.
Derived from text
Solid Propellant Combustion; Solid Propellants; Combustion Stability; Acoustics; Coupled Modes; Electrical Impedance; Pressure Oscillations

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*.

20030022691 NASA Glenn Research Center, Cleveland, OH, USA Washington State Univ., Pullman, WA, USA
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals
deGroh, H. C.; Li, K.; Li, B. Q.; February 2002; 33 pp.; In English
Contract(s)/Grant(s): NAG8-1693; Copyright; Avail: CASI; A03, Hardcopy

A 2-D finite element model is presented for the melt growth of single crystals in a microgravity environment with a superimposed DC magnetic field. The model is developed based on the deforming finite element methodology and is capable of predicting the phenomena of the steady and transient convective flows, heat transfer, solute distribution, and solid-liquid interface morphology associated with the melt growth of single crystals in microgravity with and without an applied magnetic field. Numerical simulations were carried out for a wide range of parameters including idealized microgravity conditions, the synthesized g-jitter and the real g-jitter data taken by on-board accelerometers during space flights. The results reveal that the time varying g-jitter disturbances, although small in magnitude, cause an appreciable convective flow in the liquid pool, which in turn produces detrimental effects during the space processing of single crystal growth. An applied magnetic field of appropriate strength, superimposed on microgravity, can be very effective in suppressing the deleterious effects resulting from the g-jitter disturbances.
Author
Convective Flow; Crystal Growth; Finite Element Method; Magnetic Effects; Microgravity; Single Crystals; Space Processing; Two Dimensional Models; Gravitational Effects

20030032248 NASA Glenn Research Center, Cleveland, OH, USA
The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware
OMalley, Terence F.; Myhre, Craig A.; October 02, 2000; 10 pp.; In English; 53rd International Astronautical Congress - The World Space Congress 2002, 10-19 Oct. 2002, Houston, TX, USA; Original contains black and white illustrations
Report No.(s): IAC-02-J.5.05; No Copyright; Avail: CASI; A02, Hardcopy

The Fluids and Combustion Facility (FCF) is a multi-rack payload planned for the International Space Station (ISS) that will enable the study of fluid physics and combustion science in a microgravity environment. The Combustion Integrated Rack (CIR) is one of two International Standard Payload Racks of the FCF and is being designed primarily to support combustion science experiments. The Multi-user Droplet Combustion Apparatus (MDCA) is a multi-user apparatus designed to accommodate four different droplet combustion science experiments and is the first payload for CIR. The CIR will function independently until the later launch of the Fluids Integrated Rack component of the FCF. This paper provides an overview of the capabilities and the development status of the CIR and MDCA.
Author
Combustion Chambers; Drops (Liquids); Fluid Dynamics; Microgravity; Spaceborne Experiments; Hardware

31
ENGINEERING (GENERAL)

Includes general research topics related 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*.

20030020929 North Carolina Agricultural and Technical State Univ., Greensboro, NC, USA
Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University
Monroe, Joseph; Kelkar, Ajit; March 31, 2003; 48 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NCC5-349; Proj. 98-0216; No Copyright; Avail: CASI; A03, Hardcopy

The NASA PAIR program incorporated the NASA-Sponsored research into the undergraduate environment at North Carolina Agricultural and Technical State University. This program is designed to significantly improve undergraduate

education in the areas of mathematics, science, engineering, and technology (MSET) by directly benefiting from the experiences of NASA field centers, affiliated industrial partners and academic institutions. The three basic goals of the program were enhancing core courses in MSET curriculum, upgrading core-engineering laboratories to compliment upgraded MSET curriculum, and conduct research training for undergraduates in MSET disciplines through a sophomore shadow program and through Research Experience for Undergraduates (REU) programs. Since the inception of the program nine courses have been modified to include NASA related topics and research. These courses have impacted over 900 students in the first three years of the program. The Electrical Engineering circuit's lab is completely re-equipped to include Computer controlled and data acquisition equipment. The Physics lab is upgraded to implement better sensory data acquisition to enhance students understanding of course concepts. In addition a new instrumentation laboratory in the department of Mechanical Engineering is developed. Research training for A&T students was conducted through four different programs: Apprentice program, Developers program, Sophomore Shadow program and Independent Research program. These programs provided opportunities for an average of forty students per semester.
Author
NASA Programs; Universities; Students; Education; Minorities

20030025706 NASA Langley Research Center, Hampton, VA, USA
Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation
Gasper, James L.; Pappa, Richard S.; February 2003; 13 pp.; In English; 21st International Modal Analysis Conference, 3-6 Feb. 2003, Kissimmee, FL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WU 755-06-00-21
Report No.(s): NASA/TM-2003-212150; L-18261; NAS 1.15:212150; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes the status of on-going work at the NASA Langley Research Center to measure the dynamics of thin membranes. The test article is a one-meter square pre-tensioned Kapton membrane that incorporates small surface-bonded piezoelectric patches strategically positioned to excite many modes. It is shown that PVDF (polyvinylidene fluoride) and MFC (macro fiber composite) piezoelectric patch actuators provide adequate excitation energy to obtain modal frequencies and mode shapes. Results from modal tests performed on the membrane using piezoelectric patches of different sizes and positions are discussed.
Author
Membranes; Vibration Tests; Dynamic Control; Thin Plates; Piezoelectric Actuators; Actuators

20030031369 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs)
Voellmer, George M.; Jackson, Michael L.; Shirron, Peter J.; Tuttle, James G.; [2002]; 8 pp.; In English; SPIE Conference, 21-28 Aug. 2002, Kona, HI, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The High Resolution Airborne Wideband Camera (HAWC) and the Submillimeter And Far Infrared Experiment (SAFIRE) will use identical Adiabatic Demagnetization Refrigerators (ADR) to cool their detectors to 200mK and 100mK, respectively. In order to minimize thermal loads on the salt pill, a Kevlar suspension system is used to hold it in place. An innovative, kinematic suspension system is presented. The suspension system is unique in that it consists of two parts that can be assembled and tensioned offline, and later bolted onto the salt pill.
Author
Cryogenics; Insulation; High Resolution; Cameras; Submillimeter Waves; Suspending (Mixing)

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*.

20030020930 NASA Glenn Research Center, Cleveland, OH, USA
Multi-Beam Phased Array Antennas
Lee, R. Q.; Romisch, S.; Popovic, Z.; January 2002; 10 pp.; In English; 2002 Antenna Applications Symposium, 18-20 Sep. 2002, Monticello, IL, USA
Contract(s)/Grant(s): NAG3-2587; RTOP 755-08-0B; Copyright; Avail: CASI; A02, Hardcopy

Many of NASA's future missions require multiple accesses to work together as a single system. To accomplish these missions, multi-beam phased array antennas are required to communicate between satellites flying in fixed formation. In this paper, a comparison of different multi-beam systems will be given followed by detailed discussions of the lens array architecture and test results.
Author
Multibeam Antennas; Phased Arrays; Antenna Design; Lenses; Systems Engineering; Waveguides

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*.

20030020881 Computer Sciences Corp., Moffett Field, CA, USA
Where is scattering important in nanotransistors?
Anantram, M. P.; Svizhenko, A.; February 12, 2003; 3 pp.; In English; American Physical Society Meeting, 1-7 Mar. 2003, Austin, TX, USA
Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D
Report No.(s): Rept-1; No Copyright; Avail: CASI; A01, Hardcopy

This viewgraph presentation provides an overview of scattering in nanotransistors. Topics covered include: scattering mechanisms, devices used and series resistance. The authors conclude: (1) the influence of electron-photon scattering on the on-current of dual gate MOSFET's using the non-equilibrium Green's function method and (2) the influence of the drain extension region can no longer be modeled as a series resistance.
CASI
Scattering; Metal Oxide Semiconductors; Field Effect Transistors; Nanotechnology

20030022786 Computer Sciences Corp.
Intersubband Transitions in InAs/AlSb Quantum Wells
Li, J.; Koloklov, K.; Ning, C. Z.; Larraber, D. C.; Khodaparast, G. A.; Kono, J.; Ueda, K.; Nakajima, Y.; Sasa, S.; Inoue, M.; January 20, 2003; 12 pp.; In English; MRS Fall Meeting, 1 Jan, 2003, Boston, MA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): DTT559-99-D-00437; No Copyright; Avail: CASI; A03, Hardcopy

We have studied intersubband transitions in InAs/AlSb quantum wells experimentally and theoretically. Experimentally, we performed polarization-resolved infrared absorption spectroscopy to measure intersubband absorption peak frequencies and linewidths as functions of temperature (from 4 K to room temperature) and quantum well width (from a few nm to 10 nm). To understand experimental results, we performed a self-consistent 8-band k-p band-structure calculation including spatial charge separation. Based on the calculated band structure, we developed a set of density matrix equations to compute TE and TM optical transitions self-consistently, including both interband and intersubband channels. This density matrix formalism is also ideal for the inclusion of various many-body effects, which are known to be important for intersubband transitions. Detailed comparison between experimental data and theoretical simulations is presented.
Author
Quantum Wells; Matrices (Mathematics); Optical Transition; Band Structure Of Solids; Conduction Bands; Electron Transitions; Mathematical Models; Many Body Problem

20030022789 NASA Ames Research Center, Moffett Field, CA, USA Computer Sciences Corp., USA
Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures
Kolokolov, Konstantin I.; Li, Jian-Zhong; Ning, Cun-Zheng; [2003]; 10 pp.; In English; Photonics West 2003, 25-31 Jan. 2003, San Jose, CA, USA
Contract(s)/Grant(s): RTOP 704-05-40; No Copyright; Avail: CASI; A02, Hardcopy

A method for eliminating spurious solution in the k dot p Hamiltonian has been proposed. Introduction of additional off-diagonal alpha k(exp 2) term converts spurious solution with large real wave vector to evanescent solution with large imaginary wave vector. This modification keeps the same effective masses at Gamma point and introduces negligible deviation

from original nonparabolicity. A set of unphysical fast oscillation eigenfunctions in confined states of heterostructures are removed.
Derived from text
Hamiltonian Functions; Vectors (Mathematics); Solution; Eigenvectors

20030025297 NASA Glenn Research Center, Cleveland, OH, USA
Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes
Maranchi, Jeffrey P.; Kumta, Prashant N.; Hepp, Aloysius F.; Raffaelle, Ryne P.; [2002]; 1 pp.; In English; Centennial Meeting of the Electrochemical Society, 15 May 2002, Philadelphia, PA, USA; Copyright; Avail: CASI; A01, Hardcopy

The present paper describes the integration of thin film electrodes with polymer electrolytes to form a complete thin film lithium-ion battery. Thin film batteries of the type, LiCoO2 [PAN, EC, PC, LiN(CF3SO2)2] SnO2 have been fabricated. The results of the synthesis and characterization studies will be presented and discussed.
Derived from text
Metal Ions; Thin Films; Lithium Batteries; Electrolytes; Polymers; Fabrication; Synthesis (Chemistry)

20030025756 NASA Goddard Space Flight Center, Greenbelt, MD, USA
EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts
January 2003; 46 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The January 2003 issue of Electronic, Electromechanical, Electric (EEE) Links is presented. The Programmable Logic Application Notes column has been reinstated in this newsletter. Written by Rich Katz of NASA's Office of Logic Design (OLD), the application notes offer technical tips intended to prevent flight design errors and enhance research, development, and use of programmable logic and elements for space flight applications. An archive of these notes columns from previous issues of EEE Links is available at http://www.klabs.org/richcontent/eeelink s/EEE Links.htm.
Derived from text
Plastics; Electromechanical Devices; Periodicals; Components; Microelectronics; Electric Equipment

20030031367 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Switching Oxide Traps
Oldham, Timothy R.; [2003]; 18 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

We consider radiation-induced charge trapping in SiO2 dielectric layers, primarily from the point of view of CMOS devices. However, SiO2 insulators are used in many other ways, and the same defects occur in other contexts. The key studies, which determined the nature of the oxide charge traps, were done primarily on gate oxides in CMOS devices, because that was the main radiation problem in CMOS at one time. There are two major reviews of radiation-induced oxide charge trapping already in the literature, which discuss the subject in far greater detail than is possible here. The first of these was by McLean et al. in 1989, and the second, ten years later, was intended as an update, because of additional, new work that had been reported. Basically, the picture that has emerged is that ionizing radiation creates electron-hole pairs in the oxide, and the electrons have much higher mobility than the holes. Therefore, the electrons are swept out of the oxide very rapidly by any field that is present, leaving behind any holes that escape the initial recombination process. These holes then undergo a polaron hopping transport toward the Si/SiO2 interface (under positive bias). Near the interface, some fraction of them fall into deep, relatively stable, long-lived hole traps. The nature and annealing behavior of these hole traps is the main focus of this paper.
Derived from text
Silicon Dioxide; Dielectrics; Cmos; Holes (Electron Deficiencies); Switching; Trapping

20030031368 Lockheed Martin Missiles and Space, Sunnyvale, CA, USA NASA Goddard Space Flight Center, Greenbelt, MD, USA
NiH2 Cycle Life Study
Hollandsworth, Roger P.; Armantrout, Jon D.; Rao, Gopalakrishna M.; [2002]; 30 pp.; In English; 2002 NASA Aerospace Battery Workshop, 19-21 Nov. 2002, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-32697; NAS5-5000; Copyright; Avail: CASI; A03, Hardcopy

Cycle life studies have been performed at Eagle Picher Technologies (EPT), on HST Mantech design cells with various pedigrees of slurry and dry sinter processed electrodes, to evaluate peak load voltage performance during generic load profile testing. These tests provide information for determining voltage and capacity fade (degradation) mechanisms, and their impact on nickel hydrogen cell cycle life. Comparison of peak load voltage fade, as a function of State of Charge and cycle life, with

capacity data from HST indicates that the cycle life limiting mechanism is due to impedance growth, and formation of a second discharge plateau. With a second plateau on discharge, capacity from the cell is still available, but at an unacceptable low voltage of 0.8 V per cell (17.6 V battery). Data shows that cell impedance increases with cycle number and depth of discharge, as expected.
Author
Nickel Hydrogen Batteries; Life (Durability); Electric Potential; Load Tests; Electrodes; Capacitance-Voltage Characteristics

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*.

20030020932 NASA Glenn Research Center, Cleveland, OH, USA
Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations
Sockol, Peter M.; Journal of Computational Physics; January 2002; 28 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): RTOP 708-28-11; No Copyright; Avail: CASI; A03, Hardcopy

Multigrid methods for the Navier-Stokes equations at low speeds and large temperature variations are investigated. The compressible equations with time-derivative preconditioning and preconditioned flux-difference splitting of the inviscid terms are used. Three implicit smoothers have been incorporated into a common multigrid procedure. Both full coarsening and semi-coarsening with directional fine-grid defect correction have been studied. The resulting methods have been tested on four 2D laminar problems over a range of Reynolds numbers on both uniform and highly stretched grids. Two of the three methods show efficient and robust performance over the entire range of conditions. In addition none of the methods have any difficulty with the large temperature variations.
Author
Multigrid Methods; Computational Grids; Navier-Stokes Equation; Fluid Flow; Flux Difference Splitting; Low Speed; High Temperature; Low Temperature

20030022677 NASA Glenn Research Center, Cleveland, OH, USA Washington State Univ., Pullman, WA, USA
Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity
Li, B. Q.; Shu, Y.; Li, K.; deGroh, H. C.; September 2002; 25 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): VAN00138704451; NAG8-1693; NCC8-92; WBS 02-101-53-01; No Copyright; Avail: CASI; A03, Hardcopy

Mathematical models, both 2-D and 3-D, are developed to represent g-jitter induced fluid flows and their effects on solidification under combined action of magnetic fields and microgravity. The numerical model development is based on the finite element solution of governing equations describing the transient g-jitter driven fluid flows, heat transfer and solutal transport during crystal growth with and without an applied magnetic field in space vehicles. To validate the model predictions, a ground-based g-jitter simulator is developed using the oscillating wall temperatures where timely oscillating fluid flows are measured using a laser PIV system. The measurements are compared well with numerical results obtained from the numerical models. Results show that a combined action derived from magnetic damping and microgravity can be an effective means to control the melt flow and solutal transport in space single crystal growth systems.
Author
Fluid Flow; Magnetic Fields; Mathematical Models; Microgravity; Solidification; Computational Fluid Dynamics

20030022742 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument
Ottenstein, Laura; Ku, Jentung; Feenan, David; [2003]; 10 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

An advanced thermal control system for the Burst Alert Telescope on the Swift satellite has been designed and an engineering test unit (ETU) has been built and tested in a thermal vacuum chamber. The ETU assembly consists of a propylene loop heat pipe, two constant conductance heat pipes, a variable conductance heat pipe (VCHP), which is used for rough temperature control of the system, and a radiator. The entire assembly was tested in a thermal vacuum chamber at NASA/GSFC in early 2002. Tests were performed with thermal mass to represent the instrument and with electrical resistance

heaters providing the heat to be transferred. Start-up and heat transfer of over 300 W was demonstrated with both steady and variable condenser sink temperatures. Radiator sink temperatures ranged from a high of approximately 273 K, to a low of approximately 83 K, and the system was held at a constant operating temperature of 278 K throughout most of the testing. A novel LHP temperature control methodology using both temperature-controlled electrical resistance heaters and a small VCHP was demonstrated. This paper describes the system and the tests performed and includes a discussion of the test results. Author

Temperature Control; Vacuum; Vacuum Chambers; Heat Pipes; Performance Tests; Test Stands

20030025282 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics

Yerkes, Kirk; Michalak, Travis; Silk, Eric; Swanson, Ted; McQuillen, John; Golliher, Eric; [2002]; 23 pp.; In English; International Two-Phase Thermal Control Technology Workshop, 24-26 Sep. 2002; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides information on the effects of microgravity on a spray system being developed for thermal management in aerospace environments. The presentation addresses trends in thermal technology and NASA's thermal technology needs, thermophysics experiments conducted in microgravity, and equipment for the experiments. Author

Temperature Control; Thermodynamics; Sprayers; Microgravity

20030025342 NASA Glenn Research Center, Cleveland, OH, USA

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions

Myers, Jerry G.; Hussey, Sam W.; Yee, Glenda F.; Kim, Jungho; [2003]; 3 pp.; In English; 2003 ASME Summer Heat Transfer Conference, 21-23 Jul. 2003, Las Vegas, NV, USA; Original contains black and white illustrations

Contract(s)/Grant(s): 22-400-32-30-06

Report No.(s): Paper HT2003-40591; E-13877; Copyright; Avail: CASI; A01, Hardcopy

Investigations into single bubble pool boiling phenomena are often complicated by the difficulties in obtaining time and space resolved information in the bubble region. This usually occurs because the heaters and diagnostics used to measure heat transfer data are often on the order of, or larger than, the bubble characteristic length or region of influence. This has contributed to the development of many different and sometimes contradictory models of pool boiling phenomena and dominant heat transfer mechanisms. Recent investigations by Yaddanapyddi and Kim and Demiray and Kim have obtained time and space resolved heat transfer information at the bubble/heater interface under constant temperature conditions using a novel micro-heater array (10x10 array, each heater 100 microns on a side) that is semi-transparent and doubles as a measurement sensor. By using active feedback to maintain a state of constant temperature at the heater surface, they showed that the area of influence of bubbles generated in FC-72 was much smaller than predicted by standard models and that micro-conduction/micro-convection due to re-wetting dominated heat transfer effects. This study seeks to expand on the previous work by making time and space resolved measurements under bubbles nucleating on a micro-heater array operated under constant heat flux conditions. In the planned investigation, wall temperature measurements made under a single bubble nucleation site will be synchronized with high-speed video to allow analysis of the bubble energy removal from the wall. Author

Heat Transfer; Temperature Measurement; Time Measurement; Nucleation; Bubbles; Heat Flux; Boundary Conditions

20030025361 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation

Ku, Jentung; Rodriquez, Jose; Simpson, Alda D., Technical Monitor; July 2003; 26 pp.; In English; 33rd ICES Conference, 7-10 Jul. 2003, Vancouver, BC, Canada; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents a theory that explains low frequency, high amplitude temperature oscillations in loop heat pipe (LHP) operation. Oscillations of the CC temperature with amplitudes on the order of tens of degrees Kelvin and periods on the order of hours have been observed in some LHPs during ambient testing. There are presently no satisfactory explanations for such a phenomenon in the literature. It is well-known that the operating temperature of an LHP with a single evaporator is governed by the compensation chamber (CC) temperature, which in turn is a function of the evaporator heat load, sink temperature, and ambient temperature. As the operating condition changes, the CC temperature will change during the transient but eventually reach a new steady temperature. Under certain conditions, however, the LHP never really reaches a true steady state, but

instead displays an oscillatory behavior. The proposed new theory describes why low frequency, high amplitude oscillations may occur when the LHP has a low evaporator power, a low heat sink temperature (below ambient temperature), and a large thermal mass attached to the evaporator. When this condition prevails, there are some complex interactions between the CC, condenser, thermal mass and ambient. The temperature oscillation is a result of the large movement of the vapor front inside the condenser, which is caused by a change in the net evaporator power modulated by the large thermal mass through its interaction with the sink and CC. The theory agrees very well with previously published test data. Effects of various parameters on the amplitude and frequency of the temperature oscillation are also discussed.
Author
Low Frequencies; Amplitudes; Temperature Measurement; Operating Temperature; Loops; Heat Pipes; Display Devices

20030025712 Analytical Services and Materials, Inc., Hampton, VA, USA
Source Term Model for an Array of Vortex Generator Vanes
Buning, P. G., Technical Monitor; Waithe, Kenrick A.; January 03, 2003; 23 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NASA Order L-70750-D; RTOP 714-05-10-02
Report No.(s): NASA/CR-2003-212157; NAS 1.26:212157; No Copyright; Avail: CASI; A03, Hardcopy

A source term model was developed for numerical simulations of an array of vortex generators. The source term models the side force created by a vortex generator being modeled. The model is obtained by introducing a side force to the momentum and energy equations that can adjust its strength automatically based on a local flow. The model was tested and calibrated by comparing data from numerical simulations and experiments of a single low-profile vortex generator vane, which is only a fraction of the boundary layer thickness, over a flat plate. The source term model allowed a grid reduction of about seventy percent when compared with the numerical simulations performed on a fully gridded vortex generator without adversely affecting the development and capture of the vortex created. The source term model was able to predict the shape and size of the stream wise vorticity and velocity contours very well when compared with both numerical simulations and experimental data.
Author
Vortex Generators; Computational Fluid Dynamics; Flow Velocity; Numerical Flow Visualization; Direct Numerical Simulation; Mathematical Models; Fluid Flow

20030025722 NASA Glenn Research Center, Cleveland, OH, USA
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators
Hultgren, Lennart S.; Ashpis, David E.; January 2003; 16 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Active flow control of boundary-layer separation using glow-discharge plasma actuators is studied experimentally. Separation is induced on a flat plate installed in a closed-circuit wind tunnel by a shaped insert on the opposite wall. The flow conditions represent flow over the suction surface of a modem low-pressure-turbine airfoil. The Reynolds number, based on wetted plate length and nominal exit velocity, is varied from 50,000 to 300,000, covering cruise to takeoff conditions. Low (0.2\%) and high (2.5\%) free-stream turbulence intensities are set using passive grids. A spanwise-oriented phased-plasma-array actuator, fabricated on a printed circuit board, is surface-flush-mounted upstream of the separation point and can provide forcing in a wide frequency range. Static surface pressure measurements and hot-wire anemometry of the base and controlled flows are performed and indicate that the glow-discharge plasma actuator is an effective device for separation control.
Author
Actuators; Glow Discharges; Plasmas (Physics); Active Control; Wind Tunnel Tests; Separated Flow; Fabrication

20030027075 NASA Glenn Research Center, Cleveland, OH, USA
Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions
Hultgren, Lennart S.; Ashpis, David E.; [2002]; 15 pp.; In English; American Physical Society Division of Fluid Dynamics 55th Annual Meeting, 24-26 Nov. 2002, Dallas, TX, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Active flow control of boundary-layer separation using glow-discharge plasma actuators is studied experimentally. Separation is induced on a flat plate installed in a closed-circuit wind tunnel by a shaped insert on the opposite wall. The flow conditions represent flow over the suction surface of a modern low-pressure-turbine airfoil. The Reynolds number, based on wetted plate length and nominal exit velocity, is varied from 50,000 to 300,000, covering cruise to takeoff conditions. Low (0.2\%) and high (2.5\%) free-stream turbulence intensities are set using passive grids. The base flow includes closed

separation bubbles and non-reattaching separated flow, and is thoroughly documented using single-wire constant-temperature anemometry and static surface pressure measurements. A spanwise-oriented phased-plasma-array actuator, fabricated on a printed circuit board, is surface-flush-mounted upstream of the separation point and can provide forcing in a wide frequency range. Static surface pressure measurements and hot-wire anemometry of the controlled flow are performed and indicate that the glow-discharge plasma actuator is an effective device for separation control.
Author
Active Control; Glow Discharges; Low Pressure; Turbines; Actuators; Separated Flow; Wind Tunnels

20030032255 NASA Glenn Research Center, Cleveland, OH, USA
Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions
Nahra, Henry K.; Kamotani, Y.; [2003]; 50 pp.; In English; Original document has lines across the middle of it.
Contract(s)/Grant(s): NAG3-1913; No Copyright; Avail: CASI; A03, Hardcopy

Bubble formation and detachment is an integral part of the two-phase flow science. The objective of the present work is to theoretically investigate the effects of liquid cross-flow velocity, gas flow rate embodied in the momentum flux force, and orifice diameter on bubble formation in a wall-bubble injection configuration. A two-dimensional one-stage theoretical model based on a global force balance on the bubble evolving from a wall orifice in a cross liquid flow is presented in this work. In this model, relevant forces acting on the evolving bubble are expressed in terms of the bubble center of mass coordinates and solved simultaneously. Relevant forces in low gravity included the momentum flux, shear-lift, surface tension, drag and inertia forces. Under normal gravity conditions, the buoyancy force, which is dominant under such conditions, can be added to the force balance. Two detachment criteria were applicable depending on the gas to liquid momentum force ratio. For low ratios, the time when the bubble acceleration in the direction of the detachment angle is greater or equal to zero is calculated from the bubble x and y coordinates. This time is taken as the time at which all the detaching forces that are acting on the bubble are greater or equal to the attaching forces. For high gas to liquid momentum force ratios, the time at which the y coordinate less the bubble radius equals zero is calculated. The bubble diameter is evaluated at this time as the diameter at detachment from the fact that the bubble volume is simply given by the product of the gas flow rate and time elapsed. Comparison of the model s predictions was also made with predictions from a two-dimensional normal gravity model based on Kumar-Kuloor formulation and such a comparison is presented in this work.
Author
Bubbles; Microgravity; Cross Flow; Force Distribution; Mathematical Models; Flow Velocity; Multiphase Flow; Gas Flow

35
INSTRUMENTATION AND PHOTOGRAPHY

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

20030022725 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy
Silver, E.; February 13, 2003; 4 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-5269; No Copyright; Avail: CASI; A01, Hardcopy

This is a progress report for the first year of a three year Space Research and Technology (SR&T) grant to continue the advancement of neutron transmutation doped (NTD-based) microcalorimeters. We have re-prioritized certain aspects of the statement of work and chose to emphasize issues of array development in the first year rather than wait until year two. Consequently, some of the projects scheduled for the first year were delayed to the second year. Here we report on our progress to: a) Build and test a 1 x 4 element array and to investigate electrical and thermal cross-talk; b) Build a multiplexed 4 channel analog pulse processor; c) Build a digital pulse processor that can accommodate 4 channels with independent triggers; d) Develop a proportional thermal baseline restoration system compatible with the constant voltage mode of microcalorimeter operation.
Author
Calorimeters; Germanium; Thermistors; High Resolution; X Ray Astronomy

20030025286 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Distributed Framework for Dynamic Telescope and Instrument Control

Ames, Troy J.; Case, Lynne; [2002]; 12 pp.; In English; SPIE 2002, 22-28 Aug. 2002, Waikoloa, HI, USA; Copyright; Avail: CASI; A03, Hardcopy

Traditionally, instrument command and control systems have been developed specifically for a single instrument. Such solutions are frequently expensive and are inflexible to support the next instrument development effort. NASA Goddard Space Flight Center is developing an extensible framework, known as Instrument Remote Control (IRC) that applies to any kind of instrument that can be controlled by a computer. IRC combines the platform independent processing capabilities of Java with the power of the Extensible Markup Language (XML). A key aspect of the architecture is software that is driven by an instrument description, written using the Instrument Markup Language (IML). IML is an XML dialect used to describe graphical user interfaces to control and monitor the instrument, command sets and command formats, data streams, communication mechanisms, and data processing algorithms. The IRC framework provides the ability to communicate to components anywhere on a network using the JXTA protocol for dynamic discovery of distributed components. JXTA (see httD://www.jxta.org,) is a generalized protocol that allows any devices connected by a network to communicate in a peer-to-peer manner. IRC uses JXTA to advertise a device's IML and discover devices of interest on the network. Devices can join or leave the network and thus join or leave the instrument control environment of IRC. Currently, several astronomical instruments are working with the IRC development team to develop custom components for IRC to control their instruments. These instruments include: High resolution Airborne Wideband Camera (HAWC), a first light instrument for the Stratospheric Observatory for Infrared Astronomy (SOFIA); Submillimeter And Far Infrared Experiment (SAFIRE), a Principal Investigator instrument for SOFIA; and Fabry-Perot Interferometer Bolometer Research Experiment (FIBRE), a prototype of the SAFIRE instrument, used at the Caltech Submillimeter Observatory (CSO). Most recently, we have been working with the Submillimetre High Angular Resolution Camera IInd Generation (SHARCII) at the CSO to investigate using IRC capabilities with the SHARC instrument.

Author

Astronomical Observatories; Infrared Astronomy; Telescopes; Command And Control; Data Flow Analysis; Document Markup Languages; Far Infrared Radiation; Optical Equipment

20030025334 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space

King, Michael D.; Graham, Steven M.; [2002]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

A birds eye view of the Earth from afar and up close reveals the power and magnificence of the Earth and juxtaposes the simultaneous impacts and powerlessness of humankind. The NASA Electronic Theater presents Earth science observations and visualizations in true high definition (HD) format. See the latest spectacular images from NASA & NOAA remote sensing missions like GOES, TRMM, Landsat 7, QuikScat, and Terra, which will be visualized and explained in the context of global change. Marvel at visualizations of global data sets currently available from Earth orbiting satellites, including the Earth at night with its city lights, aerosols from biomass burning, and global cloud properties. See the dynamics of vegetation growth and decay over South America over 17 years, and its contrast to the North American and Africa continents. Spectacular new visualizations of the global atmosphere & oceans will be shown. See massive dust storms sweeping across Africa and across the Atlantic to the Caribbean and Amazon basin. See ocean vortexes and currents that bring up the nutrients to feed tiny phytoplankton and draw the fish, giant whales and fisher- man. See how the ocean blooms in response to these currents and El Nino/La Nina climate changes. We will illustrate these and other topics with a dynamic theater-style presentation, along with animations of satellite launch deployments and orbital mapping to highlight aspects of Earth observations from space.

Author

Earth Observations (From Space); Planets; Biomass Burning; Climate Change; Cloud Physics; Ocean Currents; Remote Sensing

20030025374 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Material Outgassing, Identification and Deposition, MOLIDEP System

Scialdone, John J.; Montoya, Alex F.; November 2002; 8 pp.; In English; ESTECH 2003, 18-21 May 2003, Phoenix, AZ, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

The outgassing tests are performed employing a modified vacuum operated Cahn analytical microbalance, identified as the MOLIDEP system. The test measures under high vacuum, the time varying Molecular mass loss of a material sample held at a chosen temperature; it Identifies the outgassing molecular components using an inline SRS 300 amu Residual Gas Analyzer (RGA) and employs a temperature controlled 10 MHz Quartz Crystal Microbalance (QCM) to measure the

condensable DEPosits. Both the QCM and the RGA intercept within the conductive passage the outgassing products being evacuated by a turbomolecular pump. The continuous measurements of the mass loss, the rate of loss, the sample temperature, the rate of temperature change, the QCM temperature and the QCM recorded condensable deposits or rate of deposits are saved to an Excel spreadsheet. A separate computer controls the RGA.
Author
Outgassing; Deposition; Microbalances; Materials Tests

20030025388 NASA Goddard Space Flight Center, Greenbelt, MD, USA
LISA Optics Model
Waluschka, Eugene; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The Laser Interferometer Space Antenna (LISA) experiment has six telescopes, in three spacecraft, in orbit about the sun. There is a continuous two-way laser link between all of the spacecraft. The ability to make sub picometer level performance predictions about the interferometry for such a large optical system which has major subassemblies separated by 5 million kilometer distances which are constantly moving with respect to each other requires a slight extension of existing optical analysis techniques. To see this a description of the approach used to model all of the optics, in the spacecraft in orbit, is presented and the ability of this model to analyze requirements is discussed.
Author
Continuous Wave Lasers; LISA (Observatory); Spaceborne Experiments

20030025764 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Precision Pointing for the Laser Interferometry Space Antenna Mission
Hyde, T. Tupper; Bauer, Frank H., Technical Monitor; Maghami, P. G.; [2003]; 11 pp.; In English; 2003 AAS Guidance and Control Copnference, 5-9, February 2003, CO, USA; Original contains black and white illustrations
Report No.(s): AAS-03-066; No Copyright; Avail: CASI; A03, Hardcopy

The Laser Interferometer Space Antenna (LISA) mission is a planned NASA-ESA gravitational wave detector consisting of three spacecraft in heliocentric orbit. Lasers are used to measure distance fluctuations between proof masses aboard each spacecraft to the picometer level over a 5 million kilometer separation. Each spacecraft and its two laser transmit/receive telescopes must be held stable in pointing to less than 8 nanoradians per root Hertz in the frequency band 0.1-100 mHz. The pointing error is sensed in the received beam and the spacecraft attitude is controlled with a set of micro-Newton thrusters. Requirements, sensors, actuators, control design, and simulations are described.
Author
Laser Interferometry; Space Platforms; Spacecraft Antennas; Pointing Control Systems

20030032194 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy
Chambers, V. John; Mink, Ronald G.; Ohl, Raymond G.; Connelly, Joseph A.; Mentzell, J. Eric; Arnold, Steven M.; Greenhouse, Matthew A.; Winsor, Robert S.; MacKenty, John W.; [2002]; 13 pp.; In English; SPIE Conference, 21-30 Aug. 2002, Kona, HI, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The Infrared Multi-Object Spectrometer (IRMOS) is a facility-class instrument for the Kitt Peak National Observatory 4 and 2.1 meter telescopes. IRMOS is a near-IR (0.8-2.5 micron) spectrometer and operates at approximately 80 K. The 6061-T651 aluminum bench and mirrors constitute an athermal design. The instrument produces simultaneous spectra at low- to mid-resolving power (R=lambda/delta lambda= 300-3000) of approximately 100 objects in its 2.8 x 2.0 arcmin field. We describe ambient and cryogenic optical testing of the IRMOS mirrors across a broad range in spatial frequency (figure error, mid-frequency error, and microroughness). The mirrors include three rotationally symmetric, off-axis conic sections, one off-axis biconic, and several flat fold mirrors. The symmetric mirrors include convex and concave prolate and oblate ellipsoids. They range in aperture from 94x86 mm to 286x269 mm and in f-number from 0.9 to 2.4. The biconic mirror is concave and has a 94x76 mm aperture, R(sub x)=377 mm, k(sub x)=0.0778, R(sub y)=407 mm, and k(sub y)=0.1265 and is decentered by -2 mm in X and 227 mm in Y. All of the mirrors have an aspect ratio of approximately 6:1. The surface error fabrication tolerances are less than 10 nm RMS microroughness, 'best effort' for mid-frequency error, and less than 63.3 nm RMS figure error. Ambient temperature (approximately 293 K) testing is performed for each of the three surface error regimes, and figure testing is also performed at approximately 80 K. Operation of the ADE Phaseshift MicroXAM white light interferometer (micro-roughness) and the Bauer Model 200 profilometer (mid-frequency error) is described. Both the sag and conic values of the aspheric mirrors make these tests challenging. Figure testing is performed using a Zygo GPI interferometer, custom

computer generated holograms (CGH), and optomechanical alignment fiducials. Cryogenic CGH null testing is discussed in detail. We discuss complications such as the change in prescription with temperature and thermal gradients. Correction for the effect of the dewar window is also covered. We discuss the error budget for the optical test and alignment procedure. Data reduction is accomplished using commercial optical design and data analysis software packages. Results from CGH testing at cryogenic temperatures are encouraging thus far.
Author
Mirrors; Infrared Spectrometers; Instrument Errors; Design Analysis; Structural Design; Nondestructive Tests; Cryogenic Temperature; Applications Programs (Computers); Holography

20030032204 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Benchmark Problems for Space Mission Formation Flying
Carpenter, J. Russell; Leitner, Jesse A.; Folta, David C.; Burns, Richard; [2003]; 1 pp.; In English; AIAA GNC Conference, 11-14 Aug. 2003, Austin, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

To provide a high-level focus to distributed space system flight dynamics and control research, several benchmark problems are suggested for space mission formation flying. The problems cover formation flying in low altitude, near-circular Earth orbit, high altitude, highly elliptical Earth orbits, and large amplitude lissajous trajectories about co-linear libration points of the Sun-Earth/Moon system. These problems are not specific to any current or proposed mission, but instead are intended to capture high-level features that would be generic to many similar missions that are of interest to various agencies.
Author
Dynamic Control; Space Missions; Aerodynamics; Formation Flying; Libration

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*.

20030020926 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Flaw Tolerance in Lap Shear Brazed Joints, Part 1
Flom, Yury; Wang, Li-Qin; [2003]; 17 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Furnace brazing is a joining process used in the aerospace and other industries to produce strong permanent and hermetic structural joints. As in any joining process, brazed joints have various imperfections and defects. At the present time, our understanding of the influence of the internal defects on the strength of the brazed joints is not adequate. The goal of this 3-part investigation is to better understand the properties and failure mechanisms of the brazed joints containing defects. This study focuses on the behavior of the brazed lap shear joints because of their importance in manufacturing aerospace structures. In Part 1, an average shear strength capability and failure modes of the single lap joints are explored. Stainless steel specimens brazed with pure silver are tested in accordance with the AWS C3.2 standard. Comparison of the failure loads and the ultimate shear strength with the Finite Element Analysis (FEA) of the same specimens as a function of the overlap widths shows excellent correlation between the experimental and calculated values for the defect-free lap joints. A damage zone criterion is shown to work quite well in understanding the failure of the braze joints. In Part 2, the findings of the Part 1 will be verified on the larger test specimens. Also, various flaws will be introduced in the test specimens to simulate lack of braze coverage in the lap joints. Mechanical testing and FEA will be performed on these joints to verify that behavior of the flawed ductile lap joints is similar to joints with a reduced braze area. Finally, in Part 3, the results obtained in Parts 1 and 2 will be applied to the actual brazed structure to evaluate the load-carrying capability of a structural lap joint containing discontinuities. In addition, a simplified engineering procedure will be offered for the laboratory testing of the lap shear specimens.
Author
Fault Tolerance; Brazing; Lap Joints; Defects; Failure; Shear Strength; Failure Modes

20030025386 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Status on Mechanical Testing at NASA GSFC
Kaufman, Daniel; [2003]; 6 pp.; In English; International Workshop on Test Philosophies, Standards, and Methods, 18-19 Mar. 2003, Tourin, Italy; No Copyright; Avail: CASI; A02, Hardcopy

This viewgraph presentation provides an overview of current mechanical testing performed on spacecraft materials and instruments at NASA Goddard Space Flight Center. Specific mechanical testing procedures discussed include: force measurements limiting for sine, random vibration and acoustic tests, base driven model surveys, hydraulic shakers, new sine burst method and non contact sensors.
CASI
Mechanical Properties; Destructive Tests; Nondestructive Tests; Loads (Forces); Structural Analysis

20030032240 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing
Hale, Kathleen L.; Skocik, Christopher; September 13, 2002; 9 pp.; In English; Space Simulation Conference, 22-24 Oct. 2002, Ellicott City, MD, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

Space-flight hardware is required to meet specific outgassing criteria under vacuum conditions in order to reduce the risk of contaminating sensitive optics and spacecraft components. Under certain circumstances, it is desirable to measure the contamination levels that are being released from all surfaces of the test payload. This certification is often accomplished with a Total Outgassing Measurement (TOM) box. The TOM box has one 103.2 square centimeter (16 square inch) opening and one 4.84 square centimeter (0.75 square inches) opening. The larger opening allows contaminants to easily escape the box during the hardware bakeout phase. The smaller opening provides a limited conductance path for outgassed contaminants during the certification phase. A Thermoelectric Quartz Crystal Microbalance (TQCM) monitors the contamination levels inside the box to provide the total outgassing measurement. During transition from the bakeout phase to the certification phase, the TOM box is reconfigured to close the larger opening. For previous certifications, the vacuum chamber was returned to ambient conditions and the larger conductance port was closed manually. The ROS system eliminates the need to enter the chamber by remotely closing the large TOM box opening. Substantial schedule and cost savings are achieved through the use of this system. The ROS system consists of three main components; a shutter, a motion actuator, and an actuator controller. Each of these components was selected or designed to operate in an extreme-temperature and vacuum environment while providing a high level of reliability. Different types of motion actuators were considered for driving the shutter. Design parameters for the actuator included material properties, force capability, reliability, and cost.
Derived from text
Thermal Vacuum Tests; Systems Engineering; Design Analysis; Automatic Control; Mechanical Engineering; Shutters

38
QUALITY ASSURANCE AND RELIABILITY

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

20030022792 NASA Glenn Research Center, Cleveland, OH, USA
Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance
Eldridge, J. I.; Spuckler, C. M.; Nesbitt, J. A.; Street, K. W.; December 30, 2003; 22 pp.; In English; 27th Annual Cocoa Beach Conference, 26-31 Jan. 2003, Cocoa Beach, FL, USA
Contract(s)/Grant(s): WBS 22-714-04-30; No Copyright; Avail: CASI; A03, Hardcopy

Mid-infrared (MIR) reflectance is shown to be a powerful tool for monitoring the integrity of 8wt% yttria-stabilized zirconia (8YSZ) thermal barrier coatings (TBCs). Because of the translucent nature of plasma-sprayed 8YSZ TBCs, particularly at MIR wavelengths (3 to 5 microns), measured reflectance does not only originate from the TBC surface, but contains strong contributions from internal scattering within the coating as well as reflectance from the underlying TBC/substrate interface. Therefore, changes in MIR reflectance measurements can be used to monitor the progression of TBC delamination. In particular, MIR reflectance is shown to reproducibly track the progression of TBC delamination produced by repeated thermal cycling (to 1163 C) of plasma-sprayed 8YSZ TBCs on Rene N5 superalloy substrates. To understand the changes in MIR reflectance with the progression of a delamination crack network, a four-flux scattering model is used to predict the increase in MIR reflectance produced by the introduction of these cracks.
Author
Systems Health Monitoring; Infrared Radiation; Yttria-Stabilized Zirconia; Thermal Control Coatings; Spectral Reflectance; Crack Propagation

20030025272 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03)

Day, John H., Technical Monitor; LaBel, Kenneth A.; Howard, James W.; Carts, Martin A.; Seidleck, Christine; [2003]; 5 pp.; In English; Government Microcircuit Applications and Critical Technology Conference, 31 Mar. - 3 Apr. 2003, Tampa, FL, USA; Copyright; Avail: CASI; A01, Hardcopy

With the dearth of dedicated radiation hardened foundries, new and novel techniques are being developed for hardening designs using non-dedicated foundry services. In this paper, we will discuss the implications of validating these methods for the natural space radiation environment issues: total ionizing dose (TID) and single event effects (SEE). Topics of discussion include: Types of tests that are required, Design coverage (i.e., design libraries: do they need validating for each application?) A new task within NASA to compare existing design. This latter task is a new effort in FY03 utilizing a 8051 microcontroller core from multiple design hardening developers as a test vehicle to evaluate each mitigative technique.

Author

Aerospace Environments; Extraterrestrial Radiation; Foundries; Design

20030032189 NASA Goddard Space Flight Center, Greenbelt, MD, USA

NASA GSFC Mechanical Engineering Latest Inputs for Verification Standards (GEVS) Updates

Kaufman, Daniel; [2003]; 10 pp.; In English; International Workshop on Test Philosophies, Standards and Methods, 18-19 Mar. 2003, Tourin, Italy; No Copyright; Avail: CASI; A02, Hardcopy

This viewgraph presentation provides information on quality control standards in mechanical engineering. The presentation addresses safety, structural loads, nonmetallic composite structural elements, bonded structural joints, externally induced shock, random vibration, acoustic tests, and mechanical function.

CASI

Quality Control; Standards; Mechanical Engineering

20030032198 NASA Glenn Research Center, Cleveland, OH, USA

Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV

Dunlap, Patrick H., Jr.; Steinetz, Bruce M.; DeMange, Jeffrey J.; Breen, Daniel P.; November 12, 2002; 20 pp.; In English; RLV/SOV Airframe Technology Review, 19-22 Nov. 2002, Hampton, VA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

NASA's Glenn Research Center (GRC) is developing advanced control surface seal technologies for the 3rd Generation RLV program. GRC has designed several new test rigs to simulate the temperatures, pressures, and scrubbing conditions that seals would have to endure during service. A hot compression test rig and hot scrub test rig are being developed to perform tests at temperatures up to 3000 F. Another new test rig allows simultaneous seal flow and scrub tests at room temperature to evaluate changes in seal performance with scrubbing. High temperature ceramic preloading devices are being developed and evaluated as ways to improve seal resiliency.

Author

Reusable Launch Vehicles; Control Surfaces; Design Analysis; Temperature; Simulation; Pressure; Seals (Stoppers)

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 structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

20030022740 NASA Glenn Research Center, Cleveland, OH, USA

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading

Lissenden, Cliff J.; Arnold, Steven M.; Saleeb, Atef F.; Journal of Pressure Vessel Technology; February 08, 2001; 123, pp. 81-87; In English; Pressure Vessels and Piping Conference, 23-27 Jul. 2000, Seattle, WA, USA

Contract(s)/Grant(s): NCC3-597; Copyright; Avail: Other Sources

A nonproportional strain-controlled load path consisting of two segments was applied to the cobalt-based alloy Haynes 188 at 650 C. The first segment was purely axial; the aria1 strain was then held constant while the shear strain was increased during the second segment. The alloy exhibited about a 95-percent reduction in axial stress (298 to 15 MPa during shear

straining. This reduction was due primarily to plastic coupling, but time-dependent stress relaxation also occurred. A rate-independent plasticity model approximated the stress reduction due to plastic coupling reasonably well, but as expected was unable to account for time-dependent stress relaxation. A viscoplasticity model capable of predicting the interaction between stress relaxation and plastic coupling also predicted the plastic coupling reasonably well. The accuracy of the viscoplastic model is shown to depend greatly upon the set of nonunique material parameters, which must be characterized from a sufficiently large range of load histories.
Author
Shear Strain; Stress Relaxation; Viscoplasticity; Coupling; Mathematical Models; Loads (Forces)

20030025707 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Flaw Tolerance In Lap Shear Brazed Joints, Part 2
Wang, Len; Flom, Yury; February 2003; 9 pp.; In English; International Brazing and Soldering Conference, 16-19 Feb. 2003, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

This paper presents results of the second part of an on-going effort to gain better understanding of defect tolerance in braze joints. In the first part of this three-part series, we mechanically tested and modeled the strength of the lap joints as a function of the overlap distance. A failure criterion was established based on the zone damage theory, which predicts the dependence of the lap joint shear strength on the overlap distance, based on the critical size of a finite damage zone or an overloaded region in the joint. In this second part of the study, we experimentally verified the applicability of the damage zone criterion on prediction of the shear strength of the lap joint and introduced controlled flaws into the lap joints. The purpose of the study was to evaluate the lap joint strength as a function of flaw size and its location through mechanical testing and nonlinear finite element analysis (FEA) employing damage zone criterion for definition of failure. The results obtained from the second part of the investigation confirmed that the failure of the ductile lap shear brazed joints occurs when the damage zone reaches approximately 10\% of the overlap width. The same failure criterion was applicable to the lap joints containing flaws.
Author
Brazing; Lap Joints; Fault Tolerance; Shear Strength; Structural Failure

20030031351 NASA Langley Research Center, Hampton, VA, USA
Further Developments in the MLPG Method for Beam Problems
Raju, I. S.; Phillips, D. R.; CMES; 2003; Volume 4, No. 1, pp. 141-159; In English; Copyright; Avail: Other Sources

An accurate and yet simple Meshless Local Petrov-Galerkin (MLPG) formulation for analyzing beam problems is presented. In the formulation, simple weight functions are chosen as test functions as in the conventional MLPG method. Linear test functions are also chosen, leading to a variation of the MLPG method that is computationally efficient compared to the conventional implementation. The MLPG method is evaluated by applying the formulation to a variety of patch tests, thin beam problems, and problems with load discontinuities. The formulation successfully reproduces exact solutions to machine accuracy when higher order power and spline functions are chosen as test functions or when the linear test function is used, and when constructing the trial functions, the order of the basis function is properly balanced by the order of the weight function. For mixed boundary value problems, deflections, slopes, moments, and shear forces are calculated to the same accuracy by the MLPG method without the use of elaborate post-processing techniques. Problems with load discontinuities require special care - when a reasonable number of nodes are used, the method yields very accurate results.
Author
Boundary Value Problems; Galerkin Method; Patch Tests; Spline Functions; Euler-Bernoulli Beams; Weighting Functions

20030032205 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST)
Ross, Brian; Johnston, John; Smith, James; [2002]; 11 pp.; In English; Space Simulation Conference, 22-24 Oct. 2002, Ellicott City, MD, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The NGST sunshield is a lightweight, flexible structure consisting of pretensioned membranes supported by deployable booms. The structural dynamic behavior of the sunshield must be well understood in order to predict its influence on observatory dynamic performance. A 1/10th scale model of the sunshield has been developed for ground testing to provide data to validate modeling techniques for thin-film membrane structures. The validated models can then be used to predict the behavior of the full-scale sunshield. This paper provides an overview of two test series performed on the 1/10th scale sunshield and a comparison of the results from the tests.
Author
Dynamic Tests; Next Generation Space Telescope Project; Solar Radiation Shielding; Scale Models; Sun; Structural Design

42
GEOSCIENCES (GENERAL)

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

20030032202 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass

Blair, J. Bryan; Nelson, B.; dosSantos, J.; Valeriano, D.; Houghton, R.; Hofton, M.; Lutchke, S.; Sun, Q.; [2002]; 1 pp.; In English; American Geophysical Union and Large Scale Biosphere-Atmosphere Experiment in Amazonia, 7-13 Dec. 2002, San Francisco, CA, USA; Copyright; Avail: Other Sources; Abstract Only

A flight mission of NASA GSFC's Laser Vegetation Imaging Sensor (LVIS) is planned for June-August 2003 in the Amazon region of Brazil. The goal of this flight mission is to map the vegetation height and structure and ground topography of a large area of the Amazon. This data will be used to produce maps of true ground topography, vegetation height, and estimated above-ground biomass and for comparison with and potential calibration of Synthetic Aperture Radar (SAR) data. Approximately 15,000 sq. km covering various regions of the Amazon will be mapped. The LVIS sensor has the unique ability to accurately sense the ground topography beneath even the densest of forest canopies. This is achieved by using a high signal-to-noise laser altimeter to detect the very weak reflection from the ground that is available only through small gaps in between leaves and between tree canopies. Often the amount of ground signal is 1\% or less of the total returned echo. Once the ground elevation is identified, that is used as the reference surface from which we measure the vertical height and structure of the vegetation. Test data over tropical forests have shown excellent correlation between LVIS measurements and biomass, basal area, stem density, ground topography, and canopy height. Examples of laser altimetry data over forests and the relationships to biophysical parameters will be shown. Also, recent advances in the LVIS instrument will be discussed.
Author

Amazon Region (South America); Laser Altimeters; Airborne Equipment; Remote Sensing; Vegetation; Topography; Thematic Mapping

43
EARTH RESOURCES AND REMOTE SENSING

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

20030020876 Smithsonian Astrophysical Observatory, Cambridge, MA, USA

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program

Rothman, Laurence; March 2003; 15 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-8420; No Copyright; Avail: CASI; A03, Hardcopy

The purpose of this project is to develop and enhance the HITRAN molecular spectroscopic database and associated software to support the observational programs of the Earth Observing System (EOS). In particular, the focus is on the EOS projects: the Atmospheric Infrared Sounder (AIRS), the High-Resolution Dynamics Limb Sounder (HIRDLS), Measurements of Pollution in the Troposphere (MOPITT), the Tropospheric Emission Spectrometer (TES), and the Stratospheric Aerosol and Gas Experiment (SAGE III). The HITRAN program is also involved in the Ozone Monitoring Experiment (OMI). The data requirements of these programs in terms of spectroscopy are varied with respect to constituents being observed, required remote-sensing parameters, and spectral coverage. A general requisite is for additional spectral parameters and improvements to existing molecular bands sufficient for the simulation of the observations leading to retrieval of the atmospheric state. In addition, cross-section data for heavier molecular species must be expanded and made amenable to modeling in remote sensing. The effort in the project also includes developing software and distribution to make access, manipulation, and use of HITRAN functional to the EOS program.
Author

Earth Observing System (Eos); Atmospheric Chemistry; Applications Programs (Computers); Molecular Spectroscopy; Molecular Spectra; Data Acquisition; Aerosols; Data Bases

20030020877 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra

McMillian, W. Wallace; Strow, L. Larrabee; Revercomb, H.; Knuteson, R.; Thompson, A.; March 11, 2003; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG1-2022; No Copyright; Avail: CASI; A03, Hardcopy

This final report summarizes all research activities and publications undertaken as part of NASA Atmospheric Chemistry and Modeling Analysis Program (ACMAP) Grant NAG-1-2022, 'A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra'. Major project accomplishments include: (1) analysis of more than 300,000 AERI spectra from the ARM SGP site yielding a 5-year (1998-2002) timeseries of CO retrievals from the Lamont, OK AERI; (2) development of a prototype CO profile retrieval algorithm for AERI spectra; (3) validation and publication of the first CO retrievals from the Scanning High-resolution Interferometer Sounder (SHIS); and (4) development of a prototype AERI tropospheric O3 retrieval algorithm. Compilation and publication of the 5-year Lamont, OK timeseries is underway including a new collaboration with scientists at the Lawrence Berkeley National Laboratory. Public access to this data will be provided upon article submission. A comprehensive CO analysis of the archive of HIS spectra of remains as the only originally proposed activity with little progress. The greatest challenge faced in this project was motivating the University of Wisconsin Co-Investigators to deliver their archived HIS and AERIOO data along with the requisite temperature and water vapor profiles in a timely manner. Part of the supplied HIS dataset from ASHOE may be analyzed as part of a Master s Thesis under a separate project. Our success with the SAFARI 2000 SHIS CO analysis demonstrates the utility of such aircraft remote sensing data given the proper support from the instrument investigators. In addition to the PI and Co-I s, personnel involved in this CO climatology project include one Post Doctoral Fellow, one Research Scientist, two graduate students, and two undergraduate students. A total of fifteen presentations regarding research related to this project were delivered at eleven different scientific meetings. Thus far, three publications have resulted from this project with another five in preparation. No subject inventions resulted from this research project.

Author

Atmospheric Chemistry; Atmospheric Models; Troposphere; Carbon; Infrared Interferometers; Data Processing; Applications Programs (Computers); Climatology

20030020949 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Estimating Net Primary Productivity Using Satellite and Ancillary Data

Choudhury, Bhaskar J.; January 2002; 5 pp.; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA

Report No.(s): IAC-02-B.4.06; No Copyright; Avail: CASI; A01, Hardcopy

The net primary productivity (C) or the annual rate of carbon accumulation per unit ground area by terrestrial plant communities is the difference of gross photosynthesis (A(sub g)) and respiration (R) per unit ground area. Available field observations show that R is a large and variable fraction of A(sub g), although it is generally recognized that there are considerable difficulties in determining these fluxes, and thus pose challenge in assessing the accuracy. Further uncertainties arise in extrapolating field measurements (which are acquired over a hectare or so area) to regional scale. Here, an approach is presented for determining these fluxes using satellite and ancillary data to be representative of regional scale and allow assessment of interannual variation. A, has been expressed as the product of radiation use efficiency for gross photosynthesis by an unstressed canopy and intercepted photosynthetically active radiation, which is then adjusted for stresses due to soil water shortage and temperature away from optimum. R has been calculated as the sum of growth and maintenance components (respectively, R(sub g) and R(sub m)).The R(sub m) has been determined from nitrogen content of plant tissue per unit ground area, while R(sub g) has been obtained as a fraction of the difference of A(sub g) and R(sub m). Results for five consecutive years (1986-1990) are presented for the Amazon-Tocontins, Mississippi, and Ob River basins.

Author

River Basins; Ecosystems; Carbon; Vegetation; Photosynthesis; Productivity; Satellite Observation

20030022773 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer

Hall, Dorothy K.; Salomonson, Vincent V.; Riggs, George A.; Klein, Andrew G.; [2003]; 11 pp.; In English; American Society of Photogrammetry and Remote Sensing, 5-9 May 2003, Anchorage, AK, USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy

Snow and sea ice products, derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, flown on the Terra and Aqua satellites, are or will be available through the National Snow and Ice Data Center Distributed Active Archive Center (DAAC). The algorithms that produce the products are automated, thus providing a consistent global data set that is suitable for climate studies. The suite of MODIS snow products begins with a 500-m resolution, 2330-km swath snow-cover map that is then projected onto a sinusoidal grid to produce daily and 8-day composite tile products. The sequence proceeds to daily and 8-day composite climate-modeling grid (CMG) products at 0.05 resolution. A daily snow albedo product will be available in early 2003 as a beta test product. The sequence of sea ice products begins with a swath product at 1-km resolution that provides sea ice extent and ice-surface temperature (IST). The sea ice swath products are then mapped onto the Lambert azimuthal equal area or EASE-Grid projection to create a daily and 8-day composite sea ice tile product, also at 1 -km resolution. Climate-Modeling Grid (CMG) sea ice products in the EASE-Grid projection at 4-km resolution are planned for early 2003.
Author
Imaging Spectrometers; Remote Sensing; Snow Cover; Sea Ice; Computer Aided Mapping; Algorithms; Photogrammetry; Applications Programs (Computers)

20030022800 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W)
Peters, W.; Krol, M. C.; Fortuin, J. P. F.; Kelder, H. M.; Thompson, A. M.; Becker, C. R.; Lelieveld, J.; Crutzen, P. J.; [2003]; 36 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

We present an analysis of 2.5 years of weekly ozone soundings conducted at a new monitoring station in Paramaribo, Surinam (6 deg N,55 deg W). This is currently one of only three ozone sounding stations in the northern hemisphere (NH) tropics, and the only one in the equatorial Atlantic region. Paramaribo is part of the Southern Hemisphere ADditional Ozone Sounding program (SHADOZ). Due to its position close to the equator, the Inter Tropical Convergence Zone (ITCZ) passes over Paramaribo twice per year, which results in a semi-annual seasonality of many parameters including relative humidity and ozone. The dataset from Paramaribo is used to: (1) evaluate ozone variability relative to precipitation, atmospheric circulation patterns and biomass burning; (2) contrast ozone at the NH equatorial Atlantic with that at nearby southern hemisphere (SH) stations Natal (6 deg S,35 deg W) and Ascension (8 deg S,14 deg W); (3) compare the seasonality of tropospheric ozone with a satellite-derived ozone product: Tropical Tropospheric Ozone Columns from the Modified Residual method (MR-TTOC). We find that Paramaribo is a distinctly Atlantic station. Despite its position north of the equator, it resembles nearby SH stations during most of the year. Transport patterns in the lower and middle troposphere during February and March differ from SH stations, which leads to a seasonality of ozone with two maxima. MR-TTOC over Paramaribo does not match the observed seasonality of ozone due to the use of a SH ozone sonde climatology in the MR method. The Paramaribo ozone record is used to suggest an improvement for northern hemisphere MR-TTOC retrievals. We conclude that station Paramaribo shows unique features in the region, and clearly adds new information to the existing SHADOZ record.
Author
Ozone; Satellite Observation; Remote Sensing; Transport Properties; Troposphere; Atmospheric Chemistry; Climatology

20030025296 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization
Johnston, Shaida; Cordes, Joseph; [2002]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The U.S. Government is once again attempting to commercialize the Landsat program and is asking the private sector to develop a next generation mid-resolution remote sensing system that will provide continuity with the thirty-year data archive of Landsat data. Much of the case for commercializing the Landsat program rests on the apparently successful commercialization of high-resolution remote sensing activities coupled with the belief that conditions have changed since the failed attempt to commercialize Landsat in the 1980s. This paper analyzes the economic, political and technical conditions that prevailed in the 1980s as well as conditions that might account for the apparent success of the emerging high-resolution remote sensing industry today. Lessons are gleaned for the future of the Landsat program.
Author
Commercialization; Remote Sensing; Earth Resources; Satellite Imagery

20030025338 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Sensor Web and Intelligent Sensors for Earth Science Applications
Habib, Shahid; November 2002; 1 pp.; In English; Future Intelligent Earth Observing Satellites, 11 Nov. 2002, Denver, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

There is a significant interest in the Earth Science remote sensing community in substantially increasing the number of observations relative to the current frequency of collection. The obvious reason for such a push is to improve the temporal and surface coverage of measurements. However, there is little analysis available in terms of benefits, costs and optimized set of sensors needed to make these necessary observations. This is a complex problem that should be carefully studied and balanced over many boundaries. For example, the question of technology maturity versus users' desire for obtaining additional measurements is noncongruent. This is further complicated by the limitations of the laws of physics and the economic conditions. With the advent of advanced technology, it is anticipated that developments in spacecraft technology will enable advanced capabilities to become more affordable. However, specialized detector subsystems, and precision flying techniques may still require substantial innovation, development time and cost. Additionally, the space deployment scheme should also be given careful attention because of the high associated expense. Nonetheless, it is important to carefully examine the science priorities and steer the development efforts that can commensurate with the tangible requirements. This presentation will focus on a possible set of architectural concepts beneficial for future Earth science studies and research its and potential benefits. Author

Earth Sciences; Remote Sensing; Sensors; Artificial Intelligence

20030025392 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space

Hall, Dorothy K.; Bayr, Klaus J.; Schoener, Wolfgang; Bindschadler, Robert A.; Chien, Janet Y. L.; [2002]; 27 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

The tongue of the Pasterze Glacier in the eastern Alps of Austria receded more than 1152 m from 1880 to 2001. Landsat and Ikonos satellite data from 1976 to 2001, topographic maps beginning in 1893 and ground measurements were studied. Results show that though satellite images significantly underestimate the width of the Pasterze Glacier tongue due to the presence of morainal material on the surface, they provide an excellent way to measure the recession of the exposed-ice part of the glacier tongue. The rate of change of the terminus as determined using satellite data is found to compare well with ground measurements. Between 1976 and 2001, Landsat-derived measurements show a recession of the terminus of the Pasterze Glacier of 479+/-113 m (at an average rate of 18.4 m a(exp -1) while measurements from the ground showed a recession of 428 m (at an average recession of 17.1 m a(exp -1). Ikonos satellite images from 2000 and 2001 reveal changes in the exposed ice part of the Pasterze tongue, and a decrease in area of the exposed ice part of the tongue of 22,096 sq m. GPS points and a ground survey of the glacier terminus in August 2001 were plotted on a 1-m resolution Ikonos image, and showed the actual terminus shape and location. The nearby Kleines Fleisskees glacier lost 30\% of its area between 1984 and 2001, and the area of exposed ice increased by 0.44 sq km, according to Landsat satellite measurements. Recession of both the Pasterze and the Kleines Fleisskees corresponds generally to temperature and precipitation trends, especially increasing summer temperatures, as determined from meteorological data acquired from the Sonnblick Observatory, however the smaller the Kleines FleiSkees reacts more quickly to climate changes than does the Pasterze Glacier.

Author

Glaciers; Climate Change; Satellite Observation; Remote Sensing; Image Analysis; Climatology; Data Processing; Position (Location)

20030025664 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Advances In Understanding Global Water Cycle With Advent of GPM Mission

Smith, Eric A.; [2002]; 1 pp.; In English; 1st WMO/CGMS International Precipitation Working Group Workshop, 23-27 Sep. 2002, Madrid, Spain; No Copyright; Avail: Other Sources; Abstract Only

During the coming decade, the internationally organized Global Precipitation Measurement (GPM) Mission will take an important step in creating a global precipitation observing system from space based on an international fleet of satellites operated as a constellation. One perspective for understanding the nature of GPM is that it will be a hierarchical system of datastreams beginning with very high caliber combined dual frequency radar/passive microwave (PMW) rain-radiometer retrievals, to high caliber PMW rain-radiometer only retrievals, and then on to blends of the former datastreams with additional lower-caliber PMW-based and IR-based rain retrievals. Within the context of the now emerging global water & energy cycle (GWEC) programs of a number of research agencies throughout the world, GPM serves as a centerpiece space mission for improving our understanding of the Earth's water cycle from a global measurement perspective and on down to regional scales and below. One of the salient problems within our current understanding of the global water and energy cycle is determining whether a change in the rate of the water cycle is accompanying changes in climate, e.g., climate warming. As there are a number of ways in which to define a rate-change of the global water cycle, it is not entirely clear as to what constitutes such a determination. This paper first presents an overview of the GPM Mission and how its overriding scientific objectives for

climate, weather, and hydrology flow from the anticipated improvements that are being planned for the constellation-based measuring system. Next, the paper shows how the GPM observations can be used within the framework of the oceanic and continental water budget equations to determine whether a given perturbation in precipitation is indicative of an actual rate change in the water cycle, consistent with required responses in water storage and/or water flux transport processes, or whether it is simply part of the natural variability of a fixed rate cycle.
Author
Precipitation (Meteorology); Hydrological Cycle; Scientific Satellites; Remote Sensing; Data Acquisition; Data Integration

20030025762 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000
King, Michael D.; Platnick, Steven; Moeller, Christopher C.; Revercomb, Henry E.; Chu, D. Allen; [2002]; 40 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-99106; NAS5-11155; NAS5-31366; NOAA-50-SPNA-1-00039; NAG5-6996; No Copyright; Avail: CASI; A03, Hardcopy

The NASA ER-2 aircraft was deployed to southern Africa between August 17 and September 25, 2000 as part of the Southern Africa Regional Science Initiative (SAFARI) 2000. This aircraft carried a sophisticated array of multispectral scanners, multiangle spectroradiometers, a monostatic lidar, a gas correlation radiometer, upward and downward spectral flux radiometers, and two metric mapping cameras. These observations were obtained over a 3200 x 2800 km region of savanna, woody savanna, open shrubland, and grassland ecosystems throughout southern Africa, and were quite often coordinated with overflights by NASA's Terra and Landsat 7 satellites. The primary purpose of this sophisticated high altitude observing platform was to obtain independent observations of smoke, clouds, and land surfaces that could be used to check the validity of various remote sensing measurements derived by Earth-orbiting satellites. These include such things as the accuracy of the Moderate Resolution Imaging Spectro-radiometer (MODIS) cloud mask for distinguishing clouds and heavy aerosol from land and ocean surfaces, and Terra analyses of cloud optical and micro-physical properties, aerosol properties, leaf area index, vegetation index, fire occurrence, carbon monoxide, and surface radiation budget. In addition to coordination with Terra and Landsat 7 satellites, numerous flights were conducted over surface AERONET sites, flux towers in South Africa, Botswana, and Zambia, and in situ aircraft from the University of Washington, South Africa, and the UK.
Author
Remote Sensing; Spectroradiometers; Imaging Spectrometers; Multispectral Band Scanners; Atmospheric Radiation; Carbon Monoxide

20030032183 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Remote Sensing of Suspended Sediments and Shallow Coastal Waters
Li, Rong-Rong; Kaufman, Yoram J.; Gao, Bo-Cai; Davis, Curtiss O.; [2002]; 16 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

Ocean color sensors were designed mainly for remote sensing of chlorophyll concentrations over the clear open oceanic areas (case 1 water) using channels between 0.4 and 0.86 micrometers. The Moderate Resolution Imaging Spectroradiometer (MODIS) launched on the NASA Terra and Aqua Spacecrafts is equipped with narrow channels located within a wider wavelength range between 0.4 and 2.5 micrometers for a variety of remote sensing applications. The wide spectral range can provide improved capabilities for remote sensing of the more complex and turbid coastal waters (case 2 water) and for improved atmospheric corrections for Ocean scenes. In this article, we describe an empirical algorithm that uses this wide spectral range to identifying areas with suspended sediments in turbid waters and shallow waters with bottom reflections. The algorithm takes advantage of the strong water absorption at wavelengths longer than 1 micrometer that does not allow illumination of sediments in the water or a shallow ocean floor. MODIS data acquired over the east coast of China, west coast of Africa, Arabian Sea, Mississippi Delta, and west coast of Florida are used in this study.
Author
Coastal Water; Ocean Bottom; Remote Sensing; Sediments; Algorithms; Shallow Water

20030032195 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone
Randriambelo, Tantely; Baray, Jean-Luc; Baldy, Serge; Thompson, Anne M.; Oltmans, Samuel; Keckhut, Philippe; [2003]; 43 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

Since 1998, a ground based tropospheric ozone lidar has been running at Reunion Island and has been involved with a

daily measurement campaign that was performed in the latter part of the biomass burning season, during November-December 1999. The averaged ozone profile obtained during November-December 1 999 agrees well with averaged ozone profile obtained from ozonesondes launch at Reunion during November-December (1992- 2001). Comparing weekly sonde launches (part of the Southern Hemisphere Additional Ozonesondes: SHADOZ program) with the daily ground-based lidar observations shows that some striking features of the day to day variability profiles are not observed in the sonde measurements. Ozone profiles respond to the nature of disturbances which vary from the one day to the next. The vertical ozone distribution at Reunion is examined as a function of prevailing atmospheric circulation. Backtrajectories show that most of the enhanced ozone crossed over biomass burning and convectively active regions in Madagascar and the southern African continent. The analyses of the meteorological data show that ozone stratification profiles are in agreement with the movement of the synoptical situations in November-December 1999. Three different sequences of transport are explained using wind fields. The first sequence from 23 to 25 November is characterized by Northerly transport, the second sequence from 26 to 30 November, the air masses are influenced by meridional transport. The third sequence from 2 to 6 December is characterized by westerly transport associated with the subtropical jet stream. The large standard deviations of lidar profiles in the middle and upper troposphere are in agreement with the upper wind variabilities which evidence passing ridge and trough disturbances. During the transition period between the dry season and the wet season, multiple ozone sources including stratosphere-troposphere exchanges, convection and biomass burning contribute to tropospheric ozone at Reunion Island through sporadic events characterized by a large spatial and temporal variability.
Author

Troposphere; Tropical Regions; Atmospheric Chemistry; Ozone; Biomass Burning; Transport Properties; Vertical Distribution

20030032207 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Calibration Plans for the Global Precipitation Measurement (GPM)

Bidwell, S. W.; Flaming, G. M.; Adams, W. J.; Everett, D. F.; Mendelsohn, C. R.; Smith, E. A.; Turk, J.; August 2002; 1 pp.; In English; 2nd International Microwave Radiometer Calibration Workshop, 9-11 Oct. 2002, Barcelona, Spain; No Copyright; Avail: Other Sources; Abstract Only

The Global Precipitation Measurement (GPM) is an international effort led by the National Aeronautics and Space Administration (NASA) of the U.S.A. and the National Space Development Agency of Japan (NASDA) for the purpose of improving research into the global water and energy cycle. GPM will improve climate, weather, and hydrological forecasts through more frequent and more accurate measurement of precipitation world-wide. Comprised of U.S. domestic and international partners, GPM will incorporate and assimilate data streams from many spacecraft with varied orbital characteristics and instrument capabilities. Two of the satellites will be provided directly by GPM, the core satellite and a constellation member. The core satellite, at the heart of GPM, is scheduled for launch in November 2007. The core will carry a conical scanning microwave radiometer, the GPM Microwave Imager (GMI), and a two-frequency cross-track-scanning radar, the Dual-frequency Precipitation Radar (DPR). The passive microwave channels and the two radar frequencies of the core are carefully chosen for investigating the varying character of precipitation over ocean and land, and from the tropics to the high-latitudes. The DPR will enable microphysical characterization and three-dimensional profiling of precipitation. The GPM-provided constellation spacecraft will carry a GMI radiometer identical to that on the core spacecraft. This paper presents calibration plans for the GPM, including on-board instrument calibration, external calibration methods, and the role of ground validation. Particular emphasis is on plans for inter-satellite calibration of the GPM constellation. With its Unique instrument capabilities, the core spacecraft will serve as a calibration transfer standard to the GPM constellation. In particular the Dual-frequency Precipitation Radar aboard the core will check the accuracy of retrievals from the GMI radiometer and will enable improvement of the radiometer retrievals. Observational intersections of the core with the constellation spacecraft are essential in applying this technique to the member satellites. Information from core spacecraft retrievals during intersection events will be transferred to the constellation radiometer instruments in the form of improved calibration and, with experience, improved radiometric algorithms. In preparation for the transfer standard technique, comparisons using the Tropical Rainfall Measuring Mission (TRMM) with sun-synchronous radiometers have been conducted. Ongoing research involves study of critical variables in the inter-comparison, such as correlation with spatial-temporal separation of intersection events, frequency of intersection events, variable azimuth look angles, and variable resolution cells for the various sensors.
Author

Algorithms; Precipitation (Meteorology); Intercalibration; Ground Truth; Multispectral Radar; Satellite-Borne Radar; Satellite-Borne Instruments; Remote Sensors

20030032241 NASA Wallops Flight Center, Wallops Island, VA, USA
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR
Riordan, Kevin; Wright, C. Wayne; Noronha, Conan; [2003]; 1 pp.; In English; Coastal Geo Tools Conference, 6-9 Jan. 2003, Charleston, SC, USA; No Copyright; Avail: Other Sources; Abstract Only

The NASA Experimental Airborne Advanced Research LIDAR (EAARL) is a new developmental LIDAR designed to investigate and advance LIDAR techniques using a adaptive time resolved backscatter information for complex coastal research and monitoring applications. Information derived from such an advanced LIDAR system can potentially improve the ability of resource managers and policy makers to make better informed decisions. While there has been a large amount of research using LIDAR in coastal areas, most are limited in the amount of information captured from each laser pulse. The unique design of the EAARL instrument permits simultaneous acquisition of coastal environments which include subaerial bare earth topography, vegetation biomass, and bare earth beneath vegetated areas.
Author
Optical Radar; Vegetation Growth; Airborne Equipment; Research And Development; Data Acquisition

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*.

20030022670 NASA Glenn Research Center, Cleveland, OH, USA
Future Photovoltaic Power Generation for Space-Based Power Utilities
Bailey, Sheila; Landis, Geoffrey; Hepp, Aloysius; Raffaelle, Ryne; [2002]; 11 pp.; In English; 53rd International Astronautical Congress: The World Space Congress-2002, 10-19 Oct. 2002, Houston, TX, USA
Report No.(s): IAF-02-R.4.06; E-13688; Copyright; Avail: CASI; A03, Hardcopy

This paper discusses requirements for large earth orbiting power stations that can serve as central utilities for other orbiting spacecraft, or for beaming power to the earth itself. The current state of the art of space solar cells, and a variety of both evolving thin film cells as well as new technologies that may impact the future choice of space solar cells for high power mission applications are addressed.
Author
Spacecraft Power Supplies; Power Beaming; Solar Generators; Solar Power Satellites; Large Space Structures; Satellite Power Transmission; Thin Films

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*.

20030020872 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Evolution of Galaxies and the Star Formation Rate in the Infrared
Pahre, Michael A.; Oliversen, Ronald J., Technical Monitor; March 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG5-10777; No Copyright; Avail: CASI; A01, Hardcopy

A central goal of extragalactic observational astronomy is to understand how normal galaxies evolve with redshift, and particularly when galaxies formed their stars. While optical and rest-frame UV observations have begun to address these issues, the interpretation of such data is particularly challenging because of the sensitivity to dust obscuration (at optical and UV wavelengths). The absorbed light is re-radiated at IR wavelengths, hence the optimal indicators of the star formation rate (SFR) is at a rest-frame wavelength of approx. 60 microns. The SIRTF mission will revolutionize the study of the global evolution of the SFR by providing mass-selected, complete samples of galaxies and far-IR estimators of the SFR. SIRTF will be two orders of magnitude more sensitive than previous IR space missions, and therefore will open up a completely new region of parameter space in sensitivity and angular resolution. This research program will study the SFR using statistical samples of galaxies in the local universe, at intermediate redshifts, and set the stage for continuing studies up to z = 5. The overall research program is divided into three main investigations: a Mid-IR Hubble Atlas and SFR estimators in the local

universe, evolution of the SFR at 0 less than z less that 1 using pencil beam redshift surveys, and Galaxy formation and evolution at 1 less than z less than 5.
Author
Galactic Evolution; Star Formation Rate; Far Infrared Radiation; Red Shift

20030022659 Ohio Aerospace Inst., Brook Park, OH, USA
Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models
Morton, Thomas; Lyons, Valerie, Technical Monitor; October 2002; 7 pp.; In English; 5th International Workshop on Radiation Effects on Semiconductor Devices for Space applications, 9-11 Oct. 2002, Tajesaki, Japan
Contract(s)/Grant(s): NCC3-801; No Copyright; Avail: CASI; A02, Hardcopy

In this paper, we discuss the earth's trapped radiation environment, as described by the NASA models AP-8 and AE-8. We include a description of the sources and structure of the trapped radiation belts, and their dependence on external factors. After describing how to use the models to predict the environment, we present data from various space missions, and compare those data to the models. This shows the limits and strengths of the models. Finally, we describe alternative models of the trapped radiation belts, and discuss why they have not been widely adopted yet.
Author
Terrestrial Radiation; Radiation Belts; Radiation Trapping

20030022671 NASA Goddard Space Flight Center, Greenbelt, MD, USA
On the Size of the Antarctic Ozone Hole
Newman, Paul A.; Nash, Eric R.; Kawa, S. Randolph; [2002]; 1 pp.; In English; POAM Science Team Meeting, 29 Oct. 2002, Berkeley Springs, VA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Antarctic ozone hole is a region of extremely large ozone depletion that is roughly centered over the South Pole. Since 1979, the area coverage of the ozone hole has grown from near zero size to over 24 Million sq km. In the 8-year period from 1981 to 1989, the area expanded by 18 Million sq km. During the last 5 years, the hole has been observed to exceed 25 Million sq km over brief periods. In the spring of 2002, the size of the ozone hole barely reached 20 Million sq km for only a couple of days. We will review these size observations, the size trends, and the interannual variability of the size. The area is derived from the area enclosed by the 220 DU total ozone contour. We will discuss the rationale for the choice of 220 DU: 1) it is located near the steep gradient between southern mid-latitudes and the polar region, and 2) 220 DU is a value that is lower than the pre-1979 ozone observations over Antarctica during the spring period. The phenomenal growth of the ozone hole was directly caused by the increases of chlorine and bromine compounds in the stratosphere. In this talk, we will show the relationship of the ozone hole's size to the interannual variability of Antarctic spring temperatures. In addition, we will show the relationship of these same temperatures to planetary-scale wave forcings.
Author
Antarctic Regions; Ozone Depletion; Polar Regions; Bromine Compounds; Chlorine Compounds; Periodic Variations

20030022680 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA)
Tsay, Si-Chee; Hsu, Christina N.; King, Michael D.; Shu, Peter K.; [2002]; 1 pp.; In English; 2002 Workshop on GAME-T, 29-31 Oct. 2002, Chiang Rai, Thailand; No Copyright; Avail: CASI; A01, Hardcopy

Biomass burning has been a regular practice for land clearing and land conversion in many countries, especially in Africa, South America, and South East Asia. Significant global sources of greenhouse gases (e.g., CO2, CH4), chemically active gases (e.g., NO, CO, HC, CH3Br), and atmospheric aerosols are produced by biomass-burning processes, which influence the Earth-atmosphere energetics and hence impact both global climate and tropospheric chemistry. Some gases and aerosols can serve as active cloud condensation nuclei, which play important role in determining the net radiation budget, precipitation rate, and cloud lifetime. Biomass burning also affects the biogeochemical cycling of nitrogen and carbon compounds from the soil to the atmosphere; the hydrological cycle (i.e., run off and evaporation); the reflectivity and emissivity of the land; and the stability of ecosystems and ecosystem biodiversity. Compared to Africa and South America, the climatology in South East Asia reveals quite different characteristics, showing distinct large-scale smoke and cloud sources and interaction regimes. The fresh water distribution in this region is highly dependent on monsoon rainfall; in fact, the predictability of the tropical climate system is much reduced during the boreal spring, which is associated with the peak season of biomass burning activities. Estimating the burning fuel (e.g., bark, branches, and wood), an important part of studying regional carbon cycle, may rely on utilizing a wide range of distinctive spectral features in the shortwave and longwave regions. Therefore, to accurately assess

the impact of smoke aerosols in this region requires continuous observations from satellites, aircraft, networks of ground-based instruments and dedicated field experiments. A new initiative will be proposed and discussed.
Author
Aerosols; Asia; Atmospheric Chemistry; Biogeochemistry; Biomass Burning; Smoke; Ecosystems

20030022693 NASA Ames Research Center, Moffett Field, CA, USA
Automating the Processing of Earth Observation Data
Golden, Keith; Pang, Wan-Lin; Nemani, Ramakrishna; Votava, Petr; February 10, 2003; 8 pp.; In English; International Symposium on Artificial Intelligence, Robotics and Automation for Space, 19-23 May 2003, Nara, Japan; Copyright; Avail: CASI; A02, Hardcopy

NASA s vision for Earth science is to build a 'sensor web': an adaptive array of heterogeneous satellites and other sensors that will track important events, such as storms, and provide real-time information about the state of the Earth to a wide variety of customers. Achieving this vision will require automation not only in the scheduling of the observations but also in the processing of the resulting data. To address this need, we are developing a planner-based agent to automatically generate and execute data-flow programs to produce the requested data products.
Author
Automation; Earth Observations (From Space); Earth Sciences; Data Processing; Algorithms

20030022694 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Progress in Search for Antihelium with BESS
Sasaki, M.; Matsumoto, H.; Nozaki, M.; Saeki, T.; Abe, K.; Anraku, K.; Asoka, Y.; Fujikawa, M.; Fuke, H.; Imori, M., et al.; December 09, 2002; 6 pp.; In English
Contract(s)/Grant(s): RTOP 188-05-10-01
Report No.(s): NUPHBP7510; Copyright; Avail: CASI; A02, Hardcopy

We have searched for antihelium nuclei in cosmic rays using the data obtained from balloon flights of the BESS magnetic spectrometer. The search was mainly based on track-quality selection, followed by rigidity analysis, and on the time-of-flight and dE/dx measurements by the scintillation counter hodoscope. We analysed all the data collected during 1993-2000 with a common analysis procedure. No antihelium nuclei events were found in the energy range from 1 to 14 GV. In order to determine a new upper limit, we have simulated the loss in the air and in the instrument of He (He-bar) using the GEANT/GHEISHA code. Combined with the data collected in 1993 through 2000, a new 95 % confidence upper limit for the ratio of He-bar/He at the top of the atmosphere of 6.8 x 10(exp -7) has been obtained to be after correcting for the interactions in the air and in the instruments.
Author
Correction; Cosmic Rays; Magnetic Spectroscopy; Helium; Active Galactic Nuclei

20030022723 Science Applications International Corp., San Diego, CA, USA
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse
Mikic, Zoran; Linker, Jon A.; Riley, Pete; Lionello, Roberto; [2003]; 13 pp.; In English; Fall Meeting of the American Geophysical Union, 6-10 Dec. 2002, San Francisco, CA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS5-02061; No Copyright; Avail: CASI; A03, Hardcopy

The solar magnetic field plays a key role in determining coronal. The principal input to MHD models is the observed solar magnetic field. 3D MHD models can be used to compare with eclipse and coronograph images, SOHO images (LOSCO, EIT), Ulysses and WIND spacecraft data, and interplanetary scintillation (IPS) measurements. MHD computations can tell us about the structure of the corona. Eclipses can help us to verify the accuracy of the models. 4 December, 2002 total eclipce: visible in the southern hemisphere (South Atlantic, southern Africa, Indian Ocean, and Australia). Total in center Angola is at 06:00 UT.
Derived from text
Solar Corona; Solar Eclipses; Solar Magnetic Field; Wind Measurement

20030025256 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study
Wu, Liguang; Braun, Scott A.; Journal of Atmospheric Science; February 2003; 48 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The influence of the uniform large-scale flow, beta effect, and vertical shear of the environmental flow on hurricane intensity is investigated in the context of the induced convective or potential vorticity asymmetries with a hydrostatic primitive equation hurricane model. In agreement with the previous studies, imposing of one of these environmental effects can substantially weaken the simulated tropical cyclones. In response t o the environmental influence, significant asymmetries develop with a structure similar to the spiral bands in real hurricanes, which are dominated by wavenumber-one components. The tendencies of the mean radial, azimuthal winds and temperature associated with the environment-induced convective asymmetries are evaluated respectively. The resulting asymmetries can effectively reduce hurricane intensity by directly producing the negative tendency of the mean tangential wind in the vicinity of the radius of maximum wind, and by weakening the mean radial circulation. The reduction effects are closely associated with the spiral structure of the induced asymmetries. The time lag observed between the imposition of the environmental influence and the resulting rise in the minimum central pressure is the time required for developing the spiral structure. This study also confirms the axisymmetrization process associated with the induced wavenumber-one components of potential vorticity asymmetries, but it exists only within the radius of maximum wind.
Author
Asymmetry; Hurricanes; Environment Effects; Convection; Hydrostatics

20030025279 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data
Leftwich, T. E.; vonFrese, R. R. R. B.; Potts, L. V.; Roman, D. R.; Taylor, Patrick T.; [2003]; 37 pp.; In English; The Symposium on the Icelandic Plume and Crust; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-7645; Copyright; Avail: CASI; A03, Hardcopy

Seismic refraction studies have provided critical, but spatially restricted constraints on the structure of the Icelandic crust. To obtain a more comprehensive regional view of this tectonically complicated area, we spectrally correlated free-air gravity anomalies against computed gravity effects of the terrain for a crustal thickness model that also conforms to regional seismic and thermal constraints. Our regional crustal thickness estimates suggest thickened crust extends up to 500 km on either side of the Greenland-Scotland Ridge with the Iceland-Faeroe Ridge crust being less extended and on average 3-5 km thinner than the crust of the Greenland-Iceland Ridge. Crustal thickness estimates for Iceland range from 25-35 km in conformity with seismic predictions of a cooler, thicker crust. However, the deepening of our gravity-inferred Moho relative to seismic estimates at the thermal plume and rift zones of Iceland suggests partial melting. The amount of partial melting may range from about 8\% beneath the rift zones to perhaps 20\% above the plume core where mantle temperatures may be 200-400 C above normal. Beneath Iceland, areally limited regions of partial melting may also be compositionally and mechanically layered
Author
Earth Crust; Gravity Anomalies; Iceland; Seismology

20030025330 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation
Poli, Paul; Ao, Chi On; Joiner, Joanna; delaTorreJuarez, Manuel; Hoff, Raymond; [2002]; 8 pp.; In English; First International Workshop on Occultations for Probing Atmosphere & Climate (OPAC-1), 16-20 Sep. 2002, Graz, Austria; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

The GeoForschungsZentrum's Challenging Minisatellite Payload for Geophysical Research and Application (CHAMP, Germany-US) and the Comision Nacional de Actividades Especiales' Satelite de Aplicaciones Cientificas-C (SAC-C, Argentina-US) missions are the first missions to carry a second-generation Blackjack Global Positioning System (GPS) receiver. One of the new features of this receiver is its ability to sense the lower troposphere closer to the surface than the proof-of-concept GPS Meteorology experiment (GPS/MET). Since their launch, CHAMP and SAC-C have collected thousands of GPS radio occultations, representing a wealth of measurements available for data assimilation and Numerical Weather Prediction (NWP). In order to evaluate the refractivity data derived by the Jet Propulsion Laboratory (JPL) from raw radio occultation measurements, we use Data Assimilation Office (DAO) 6-hour forecasts as an independent state of the atmosphere. We compare CHAMP and SAC-C refractivity (processed by JPL) with refractivity calculated from the DAO global fields of temperature, water vapor content and humidity. We show statistics of the differences as well as histograms of the differences.
Author
Global Positioning System; Radio Occultation; Earth Limb; Refractivity; Troposphere

20030025336 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies

Kim, Hyung Rae; vonFrese, Ralph R. B.; Taylor, Patrick T.; Kim, Jeong Woo; Park, Chan Hong; [2003]; 4 pp.; In English; Orsted 4 Meetings, Denmark; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-7645; Copyright; Avail: CASI; A01, Hardcopy

Regional to continental scale magnetic anomaly maps are becoming increasingly available from airborne, shipborne, and terrestrial surveys. Satellite data are commonly considered to fill the coverage gaps in regional compilations of these near-surface surveys. For the near-surface Antarctic magnetic anomaly map being produced by the Antarctic Digital Magnetic Anomaly Project (ADMAP), we show that near-surface magnetic anomaly estimation is greatly enhanced by the joint inversion of the near-surface data with the satellite observations relative to the conventional technique such as minimum curvature. Orsted observations are especially advantageous relative to the Magsat data that have order-of-magnitude greater measurement errors, albeit at much lower orbital altitudes. CHAMP is observing the geomagnetic field with the same measurement accuracy as the Orsted mission, but at the lower orbital altitudes covered by Magsat. Hence, additional significant improvement in predicting near-surface magnetic anomalies can result as these CHAMP data are available. Our analysis also suggests that considerable new insights on the magnetic properties of the lithosphere may be revealed by a further order-of-magnitude improvement in the accuracy of the magnetometer measurements at minimum orbital altitude.

Author

Magnetic Anomalies; Satellite Observation; Geomagnetism; Satellite Instruments; Computerized Simulation

20030025379 Naval Research Lab., Washington, DC, USA

High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System

Coy, L.; Stajner, I.; DaSilva, A. M.; Joiner, J.; Rood, R. B.; Pawson, S.; Lin, S. J.; [2003]; 57 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A04, Hardcopy

This study examines the winter southern hemisphere vortex of 1998 using four times daily output from a data assimilation system to focus on the polar 2-day, wave number 2 component of the 4-day wave. The data assimilation system products are from a test version of the finite volume data assimilation system (fvDAS) being developed at Goddard Space Flight Center (GSFC) and include an ozone assimilation system. Results show that the polar 2-day wave dominates during July 1998 at 70 degrees. The period of the quasi 2-day wave is somewhat shorter than 2 days (about 1.7 days) during July 1998 with an average perturbation temperature amplitude for the month of over 2.5 K. The 2-day wave propagates more slowly than the zonal mean zonal wind, consistent with Rossby wave theory, and has EP flux divergence regions associated with regions of negative horizontal potential vorticity gradients, as expected from linear instability theory. Results for the assimilation-produced ozone mixing ratio show that the 2-day wave represents a major source of ozone variation in this region. The ozone wave in the assimilation system is in good agreement with the wave seen in the POAM (Polar Ozone and Aerosol Measurement) ozone observations for the same time period. Some differences with linear instability theory are noted as well as spectral peaks in the ozone field, not seen in the temperature field, that may be a consequence of advection.

Author

Planetary Waves; High Frequencies; Wind (Meteorology); Ozone; Southern Hemisphere; Data Acquisition

20030025381 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model

Tao, Wei-Kuo; [2002]; 2 pp.; In English; NASA Ames, Naval Post Graduate School and Naval Research Laboratory, 15-20 Sep. 2002, Monterery, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

In this talk, five specific major GCE improvements: (1) ice microphysics, (2) longwave and shortwave radiative transfer processes, (3) land surface processes, (4) ocean surface fluxes and (5) ocean mixed layer processes are presented. The performance of these new GCE improvements will be examined. Observations are used for model validation.

Derived from text

Atmospheric Models; Cumulus Clouds; Ocean Surface; Climatology; Meteorology

20030025403 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux

Olsen, M. A.; Douglass, A. R.; Schoeber, M. R.; January 2003; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A novel method of calculating the downward ozone flux across the midlatitude (30 deg-60 deg) tropopause shows the

Northern Hemisphere (NH) ozone flux to be significantly larger (approximately 24\%) than that calculated in the Southern Hemisphere (SH) during the year 2000. This diagnostic method makes it possible to separate dynamical aspects of transport from the seasonal cycle of ozone in the lowermost stratosphere and explain the hemispheric difference in the ozone flux. The SH total horizontal area of exchange is equal to or slightly greater than the area of exchange in the NH throughout an annual cycle. The mean changes in potential vorticity of parcels near the tropopause are also similar or slightly greater in the SH, suggesting that NH and SH downward total mass transport to the troposphere are comparable. These results imply that the greater NH ozone flux is mostly due to the amount of ozone available for exchange rather than net hemispheric dynamical differences near the tropopause level.
Author
Northern Hemisphere; Ozone; Southern Hemisphere; Tropopause; Wind (Meteorology)

20030025440 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity
Chao, B. F.; Gross, R. S.; January 2002; 1 pp.; In English; IERS Workshop on Combination Research and Global Geophysical Fluids, 18-21 Nov. 2002, Munich, Germany; No Copyright; Avail: Other Sources; Abstract Only

Mantle processes often involve large-scale mass transport, ranging from mantle convection, tectonic motions, glacial isostatic adjustment, to tides, atmospheric and oceanic loadings, volcanism and seismicity. On very short time scale of less than an hour, co-seismic event, apart from the shaking that is the earthquake, leaves behind permanent (step-function-like) dislocations in the crust and mantle. This redistribution of mass changes the Earth's inertia tensor (and hence Earth's rotation in both length-of-day and polar motion), and the gravity field (in terms of spherical harmonic Stokes coefficients). The question is whether these effects are large enough to be of any significance. In this paper we report updated calculation results based on Chao & Gross (1987). The calculation uses the normal mode summation scheme, applied to nearly twenty thousand major earthquakes that occurred during 1976-2002, according to source mechanism solutions given by the Harvard Central Moment Tensor catalog. Compared to the truly large ones earlier in the century, the earthquakes we study are individually all too small to have left any discernible signature in geodetic records of Earth rotation or global gravity field. However, their collective effects continue to exhibit an extremely strong statistical tendencies. For example, earthquakes conspire to decrease J2 and J22 while shortening LOD, resulting in a rounder and more compact Earth. Strong tendency is also seen in the earthquakes trying to nudge the Earth rotation pole towards approximately 140 degrees E, roughly opposite to the observed polar drift direction. The geophysical significance and implications will be further studied.
Author
Earth Rotation; Gravitation; Seismology; Volcanology; Geophysics; Earth Mantle

20030025661 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects
Chao, Benjamin F.; [2003]; 1 pp.; In English; Workshop on GPS Meteorology: Ground-Based and Space-Borne Applications, 14-17 Jan. 2003, Tsukuba, Japan; No Copyright; Avail: Other Sources; Abstract Only

Any large mass transport in the Earth system produces changes in the gravity field. Via the space geodetic technique of satellite-laser ranging in the last quarter century, the Earth's dynamic oblateness J2 (the lowest-degree harmonic component of the gravity field) has been observed to undergo a slight decrease -- until around 1998, when it switched quite suddenly to an increase trend which has continued to date. The secular decrease in J2 has long been attributed primarily to the post-glacial rebound in the mantle; the present increase signifies an even larger change in global mass distribution whose J2 effect overshadows that of the post-glacial rebound, at least over interannual timescales. Intriguing evidences have been found in the ocean water distribution, especially in the extratropical Pacific basins, that may be responsible for this J2 change. New techniques based on satellite-to-satellite tracking will yield greatly improved observations for time-variable gravity, with much higher precision and spatial resolution (i.e., much higher harmonic degrees). The most important example is the GRACE mission launched in March 2002, following the success of the CHAMP mission. In addition, although less precise than GRACE, the GPS/Meteorology constellation mission COSMIC, with 6 mini-satellites to be launched in late 2005, is expected to provide continued and complementary time-variable gravity observations. Such observations are becoming a new and powerful tool for remote sensing of geophysical fluid processes that involve larger-scale mass transports.
Author
Earth Gravitation; Gravitational Fields; Satellite Laser Ranging; Mass Distribution; Gravity Anomalies; Mass Transfer

20030031378 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae

Gull, T. R.; Vieira, G.; Danks, A.; January 2003; 2 pp.; In English; AAS 201st Meeting, 5 Jan. 2003, Seattle, WA, USA; No Copyright; Avail: Other Sources; Abstract Only

Between 2400A to 3160A, we have identified approximately 500 absorption line complexes, each with up to 20 velocity components. Lines of Fe I, Fe II, Ti II, V II, Ni II, Co II, Mn II, Mg I, Mg II and Na I have been identified. Surprisingly, most of the lines originate from energy levels significantly above the ground level. This is indcative of optical pumping from the Central Source. Line widths and population of various levels are non-thermal. The relative column densities change with velocity. For example, Fe 11 column densities for one transition arising from approx. 0.l ev increase with ejecta velocity while Fe 11 column densities for another transition decreases with velocity. This may be due to softening of the ultraviolet radiation that pumps the various ions (neutrals) with velocity. If we assume that the distance of each system scales with distance from the Central Source, only a thirty percent change in distance is noted; yet the ratio of column densities for the Fe I1 examples given above changes by nearly thirty-fold. If the ejecta distance scales with distance from Eta Carinae, then it is likely that this ejecta originated at nearly the same time. The geometry of the Homunculus has been determined to be a double-lobed structure tilted out of the plane of the sky. We interpret the ejecta as being in the wall of the Southwest lobe, and that this wall just happens to be in line of sight from Eta Carinae to the observer. As Eta Carinae enters into the upcoming minimum, we are already seeing some evidence for changes in column densities due to changes in ultraviolet fluxes. This is reinforced by IUE observations that we have recently re-analyzed with respect to the 5.52 year (2020 +/- 10 days) spectroscopic period. Observations were done through STScI and funding was through the STIS GTO resources.

Author

Ejecta; Absorption Spectra; Energy Levels; Line Spectra; Ultraviolet Radiation

20030032180 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE

Levy, Robert C.; Remer, Lorraine A.; Tanre, Didier; Kaufman, Yoram J.; Ichoku, Charles; Holben, Brent N.; Livingston, John M.; Russell, Philip B.; Maring, Hal; [2002]; 43 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy

The Puerto Rico Dust Experiment (PRIDE) took place in Roosevelt Roads, Puerto Rico from June 26 to July 24,2000 to study the radiative and physical properties of African dust aerosol transported into the region. PRIDE had the unique distinction of being the first major field experiment to allow direct comparison of aerosol retrievals from the MODerate Imaging Spectro-radiometer (MODIS) with sunphotometer and in-situ aerosol measurements. Over the ocean, the MODIS algorithm retrieves aerosol optical depth (AOD) as well as information about the aerosols size distribution. During PRIDE, MODIS derived AODs in the red wavelengths (0.66 micrometers) compare closely with AODs measured from sunphotometers, but, are too large at blue and green wavelengths (0.47 and 0.55 micrometers) and too small in the infrared (0.87 micrometers). This discrepancy of spectral slope results in particle size distributions retrieved by MODIS that are small compared to in-situ measurements, and smaller still when compared to sunphotometer sky radiance inversions. The differences in size distributions are, at least in part, associated with MODIS simplification of dust as spherical particles. Analysis of this PRIDE data set is a first step towards derivation of realistic non-spherical models for future MODIS retrievals.

Author

Imaging Spectrometers; Aerosols; Dust; Ocean Surface; Puerto Rico; Photometers

20030032184 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy

Moskalenko, I. V.; Strong, A. W.; Mashnik, S. G.; Ormes, J. F.; Jones, F. C.; [2002]; 1 pp.; In English

Report No.(s): LA-UR-02-2996; No Copyright; Avail: Other Sources; Abstract Only

Recent more accurate antiproton data obtained by the BESS team during the last solar minimum pose a challenge to conventional propagation models of cosmic rays. In particular, the diffusive reacceleration model, which matches well key secondary/primary isotope ratios in cosmic rays, fails to reproduce the secondary antiproton spectrum. Tuning both secondary/primary isotope ratios and antiprotons is possible, but requires artificial breaks in the diffusion coefficient and the injection spectrum of primaries. We will discuss some possibilities to overcome these difficulties in the propagation models. We will present new results of our calculation of CR propagation in the Galaxy using the GALPROP code.

Author

Cosmic Rays; Galaxies; Antiprotons; Propagation (Extension)

20030032197 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Atmospheric products from the Upper Atmosphere Research Satellite (UARS)

Ahmad, Suraiya P.; Johnson, James E.; Jackman, Charles H.; January 2003; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper provides information on the products available at the NASA Goddard Earth Sciences (GES) Distributed Active Archive Center (DAAC) from the Upper Atmosphere Research Satellite (UARS) mission. The GES DAAC provides measurements from the primary UARS mission, which extended from launch in September 1991 through September 2001. The ten instruments aboard UARS provide measurements of atmospheric trace gas species, dynamical variables, solar irradiance input, and particle energy flux. All standard Level 3 UARS products from all ten instruments are offered free to the public and science user community. The Level 3 data are geophysical parameters, which have been transformed into a common format and equally spaced along the measurement trajectory. The UARS data have been reprocessed several times over the years following improvements to the processing algorithms. The UARS data offered from the GES DAAC are the latest versions of each instrument. The UARS data may be accessed through the GES DAAC website at

Author

Atmospheric Chemistry; Atmospheric Composition; Flux Density; Gas Composition; Trace Contaminants

20030032236 Maryland Univ. Baltimore County, Baltimore, MD, USA

Effects of Non-Sphericity on Mineral Dust Modeling

Ginoux, Paul; Torres, O.; Journal of Geophysical Research; January 2003; ISSN, pp. 1-7; In English

Contract(s)/Grant(s): NAG3-5694; 0148-0227; Copyright; Avail: CASI; A03, Hardcopy

The dependency of non-sphericity on gravitational settling of mineral dust particles is parameterized for prolate ellipsoids and Reynolds number lower than 2. The settling speed is numerically solved from the momentum equation as a function of particle diameter and aspect ratio. The reduction of settling speed due to non-sphericity is included in the GO-CART model to simulate dust size distribution for April 2001. Two numerical schemes for solving sedimentation are compared. For particles of diameter greater than 5 micron the simulated size distribution is sensitive to the numerical sedimentation scheme. Changing the particle shape from spherical to non-spherical with lambda=2, makes little difference to the simulated surface concentration and size distribution except at the periphery of the dust sources. However, when very elongated particles (lambda=5) are simulated the differences between non-spherical and spherical particles are significant. With limited in-situ measurements reporting most frequent lambda around 1.5, the overall effects on global modeling is rather negligible and the essential benefit is to relax the CFL condition of Eulerian settling schemes.

Author

Dust; Aerosols; Optical Properties; Shapes; Atmospheric Models; Ellipsoids; Particle Motion; Particle Size Distribution

20030032257 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle)

Chao, Benjamin F.; [2002]; 1 pp.; In English; American Geophysical Union Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Global Geophysical Fluids Center (GGFC) was established by the International Earth Rotation Service (IERS) on IERS's 10th anniversary day January 1, 1998, in an effort to expand IERS's services to the scientific community. Under the GGFC, eight Special Bureaus (SB) have been selected, each to be responsible for research and data service activities pertaining to mass transports and related geophysical processes in specific components of the Earth system, or 'global geophysical fluids,' including the atmosphere, oceans, solid Earth, core, and geophysical processes of gravity, loading, tides and hydrological cycles. GGFC and the SBs have the responsibility of supporting, facilitating, and providing services to the worldwide research community, in areas related to the variations in Earth rotation, gravity field and geocenter that are caused by mass transport in the global geophysical fluids. These minute variations have been observed by various space geodetic techniques, as effective remote sensing tools, with ever increasing precision/accuracy and temporal/spatial resolution. The GGFC and SBs have organized dedicated workshops and special sessions at international conferences, published articles, and held regular business meetings. The SBs also maintain individual website for data services and information exchanges. See URL <bowie.gsfc.nasa.gov/ggfc/>. In particular, the SB for Mantle focuses on large-scale mass redistributions that occur in the mantle in association with various dynamic processes, including seismic activities, the post-glacial rebound, and mantle convections.

Author

Earth Rotation; Geophysics; Earth Mantle; Geophysical Fluids; Mass Transfer; Seismic Energy

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20030020879 Old Dominion Univ., Norfolk, VA, USA
A Product Development Decision Model for Cockpit Weather Information Systems
Sireli, Yesim; Kauffmann, Paul; Gupta, Surabhi; Kachroo, Pushkin; January 2003; 71 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG1-2278; No Copyright; Avail: CASI; A04, Hardcopy

There is a significant market demand for advanced cockpit weather information products. However, it is unclear how to identify the most promising technological options that provide the desired mix of consumer requirements by employing feasible technical systems at a price that achieves market success. This study develops a unique product development decision model that employs Quality Function Deployment (QFD) and Kano's model of consumer choice. This model is specifically designed for exploration and resolution of this and similar information technology related product development problems.
Author
Product Development; Decision Making; Cockpit Weather Information Systems; Models

20030020880 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000)
Thompson, Anne M.; Witte, Jacquelyn C.; Freiman, M. Tai; Phalane, N. Agnes; Coetzee, Gert J. R.; January 2002; 1 pp.; In English; Joint CACGP/IGAC 2002 Symposium, 18-25 Sep. 2002, Heraklion, Greece; No Copyright; Avail: Other Sources; Abstract Only

In early September, throughout south central Africa, seasonal clearing of dry vegetation and the production of charcoal for cooking leads to intense smoke haze and ozone formation. Ozone soundings made over Lusaka in early September 2000 recorded layers of high ozone (greater than 125 ppbv at 5 km) during two stagnant periods, broken by a frontal passage that reduced boundary layer ozone by 30\%. During the 6-day measurement period, surface ozone concentrations ranged from 50-95 ppbv and integrated tropospheric ozone from the soundings was 39-54 Dobson Units (note 1.3 km elevation at the launch site). A stable layer of high ozone at 2-5 km was advected from rural burning regions in western Zambia and neighboring countries, making Lusaka a collection point for transboundary pollution. This is confirmed by trajectories that show ozone leaving Angola, Namibia, Botswana and South Africa before heading toward the Indian Ocean and returning to Lusaka via Mozambique and Zimbabwe. Ozone in the mixed layer at Lusaka is heavily influenced by local sources.
Author
Ozone; Africa; Transport Properties; Optical Thickness; Aerosols; Smoke

20030020951 Maryland Univ. Baltimore County, Catonsville, MD, USA
SPARC Intercomparison of Middle Atmosphere Climatologies
Randel, William; Fleming, Eric; Geller, Marvin; Hamilton, Kevin; Karoly, David; Ortland, Dave; Pawson, Steve; Swinbank, Richard; Udelhofen, Petra; July 11, 2002; 142 pp.; In English; Copyright; Avail: CASI; A07, Hardcopy

This atlas presents detailed incomparisons of several climatological wind and temperature data sets which cover the middle atmosphere (over altitudes approx. 10-80 km). A number of middle atmosphere climatologies have been developed in the research community based on a variety of meteorological analyses and satellite data sets. Here we present comparisons between these climatological data sets for a number of basic circulation statistics, such as zonal mean temperature, winds and eddy flux statistics. Special attention is focused on tropical winds and temperatures, where large differences exist among separate analyses. We also include comparisons between the global climatologies and historical rocketsonde wind and temperature measurements, and also with more recent lidar temperature data. These comparisons highlight differences and uncertainties in contemporary middle atmosphere data sets, and allow biases in particular analyses to be isolated. In addition, a brief atlas of zonal mean temperature and wind statistics is provided to highlight data availability and as a quick-look reference. This technical report is intended as a companion to the climatological data sets held in archive at the SPARC Data Center (http://www.sparc.sunysb.edu).
Author
Middle Atmosphere; Wind (Meteorology); Atmospheric Temperature; Climatology; Atmospheric Circulation

20030022663 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Sun's Impact on Climate

Cahalan, Robert; January 2002; 1 pp.; In English; Source Science Team Meeting, 17-19 Jul. 2002; No Copyright; Avail: Other Sources; Abstract Only

We provide an overview of the impact of the Sun on the Earth atmosphere and climate system, focused on heating of Earth's atmosphere and oceans. We emphasize the importance of the spectral measurements of SIM and SOLSTICE- that we must know how solar variations are distributed over ultraviolet, visible, and infrared wavelengths, since these have separate characteristic influences on Earth's ozone layer, clouds, and upper layers of the oceans. Emphasis is also given to understanding both direct and indirect influences of the Sun on the Earth, which involve feedbacks between Earth's stratosphere, troposphere, and oceans, each with unique time scales, dynamics, chemistry, and biology, interacting non-linearly. Especially crucial is the role of all three phases of water on Earth, water vapor being the primary greenhouse gas in the atmosphere, the importance of trace gases such as CO2 arising from their absorption in the 'water vapor window' at 800 - 1250/cm (12.5 to 8 microns). Melting of polar ice is one major response to the post-industrial global warming, enhanced due to 'ice-albedo' feedback. Finally, water in liquid form has a major influence due to cloud albedo feedback, and also due to the oceans' absorption of solar radiation, particularly at visible wavelengths, through the visible 'liquid water window' that allows penetration of visible light deep into the mixed layer, while nearby ultraviolet and infrared wavelengths do not penetrate past the upper centimeter ocean surface skin layer. A large fraction of solar energy absorbed by the oceans goes into the latent heat of evaporation. Thus the solar heating of the atmosphere-ocean system is strongly coupled through the water cycle of evaporation, cloud formation, precipitation, surface runoff and ice formation, to Earth's energy budget and climate, each different climate component responding to variations in different solar spectral bands, at ultraviolet, visible and infrared wavelengths.

Author

Climate Change; Earth Atmosphere; Global Warming; Oceans; Solar Heating; Solar Radiation; Atmospheric Effects

20030022687 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations

Tao, Wei-Kuo; Khain, A.; Simpson, S.; Johnson, D.; Li, X.; Remer, L.; [2003]; 1 pp.; In English; IUGG/IaMAS, 30 Jun. - 11 Jul. 2003, Sapporo, Japan; No Copyright; Avail: Other Sources; Abstract Only

Cloud microphysics are inevitably affected by the smoke particle (CCN, cloud condensation nuclei) size distributions below the clouds. Therefore, size distributions parameterized as spectral bin microphysics are needed to explicitly study the effects of atmospheric aerosol concentration on cloud development, rainfall production, and rainfall rates for convective clouds. Recently, two detailed spectral-bin microphysical schemes were implemented into the Goddard Cumulus Ensemble (GCE) model. The formulation for the explicit spectral-bin microphysical processes is based on solving stochastic kinetic equations for the size distribution functions of water droplets (i.e., cloud droplets and raindrops), and several types of ice particles [i.e.,pristine ice crystals (columnar and plate-like), snow (dendrites and aggregates), graupel and frozen drops/hail]. Each type is described by a special size distribution function containing many categories (i.e. 33 bins). Atmospheric aerosols are also described using number density size-distribution functions.A spectral-bin microphysical model is very expensive from a from a computational point of view and has only been implemented into the 2D version of the GCE at the present time. The model is tested by studying the evolution of deep tropical clouds in the west Pacific warm pool region using identical thermodynamic conditions but with different concentrations of CCN: a low 'clean' concentration and a high 'dirty' concentration. Besides the initial differences in aerosol concentration, preliminary results indicate that the low CCN concentration case produces rainfall at the surface sooner than the high CCN case but has less cloud water mass aloft. Because the spectral-bin model explicitly calculates and allows for the examination of both the mass and number concentration of species in each size categor, a detailed analysis of the instantaneous size spectrum can be obtained for the two cases. It is shown that since the low CCN case produces fewer droplets, larger sized develop due to the greater condensational and collectional growth, leading to a broader size spectrum in comparison to the high CCN case.

Author

Atmospheric Models; Aerosols; Clouds (Meteorology); Cloud Physics; Size Distribution; Low Concentrations; Condensation Nuclei; Distribution Functions

20030022697 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program

Smith, Eric A.; [2002]; 1 pp.; In English; Second International Symposium on Earth Observation from Space, 14 Nov. 2002, Osaka, Japan; No Copyright; Avail: Other Sources; Abstract Only

During the coming decade, the internationally organized Global Precipitation Measurement (GPM) Mission will take an important step in creating a global precipitation observing system from space based on an international fleet of satellites operated as a constellation of opportunity. One perspective for understanding the nature of GPM is that it will be a hierarchical system of datastreams beginning with very high caliber combined dual frequency radar/passive microwave (PMW) rain-radiometer retrievals, to high caliber PMW rain- radiometer only retrievals, and then on to blends of the former datastreams with additional lower-caliber PMW-based and IR-based rain retrievals. Within the context of the now emerging global water & energy cycle (GWEC) programs of a number of research agencies throughout the world, GPM serves as a centerpiece space mission for improving our understanding of the Earth's water cycle from a global measurement perspective and on down to regional scales and below. One of the salient problems within our current understanding of the global water and energy cycle is determining whether a change in the rate of the water cycle is accompanying changes in climate, e.g., climate warming. As there are a number of ways in which to define a rate- change of the global water cycle, it is not entirely clear as to what constitutes such a determination. This paper first presents an overview of the GPM Mission and how its overriding scientific objectives for climate, weather, and hydrology flow from the anticipated improvements that are being planned for the constellation-based measuring system. Next, the paper shows how the GPM observations can be used within the framework of the oceanic and continental water budget equations to determine whether a given perturbation in precipitation is indicative of an actual rate change in the water cycle, consistent with required responses in water storage and/or water flux transport processes, or whether it is simply part of the natural variability of a fixed rate cycle.
Author
Climate; Hydrology; Rain; Water; Weather

20030022771 Simpson Weather Associates, Inc., Charlottesville, VA, USA
Tropospheric Wind Observations with Doppler Lidars
April 14, 2003; 3 pp.; In English
Contract(s)/Grant(s): NAS8-98046; Copyright; Avail: CASI; A01, Hardcopy

Simpson Weather Associates has continued its efforts on the tools which operate the DLSM's s line-of-sight output products file. Due to the long model run times which were revealed in last month's benchmark tests, four model options for the LSM's atmospheric inputs are now included in the LSM. The user can choose to either spatially and/or temporally interpolate the inputs or use inputs closest to the DWL shot. A problem in the terrain assignment from the GADS was corrected. A database conversion tool was added to convert DWL line-of-sight ASCII files into database format for the graphic display models. Efforts have continued in simulating DWL horizontal wind components using the DAO ficcm Nature Run. Experiments 2 and 3 (40 days worth) were completed and sent to the DAO for their use in bracketing OSSE experiments. In addition, in order to investigate differences in the way regional (MM5) and global scale (ECMWF T213) models treat features such as clouds and subgrid scale variability, a gridded Mesoscale Atmospheric Data Set (MADS) was created and ready to be incorporated into simulation experiments.
Author
Atmospheric Models; Optical Radar; Computerized Simulation; Troposphere; Wind Measurement

20030022775 Maryland Univ. Baltimore County, Baltimore, MD, USA
Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation
Ginoux, P.; Prospero, J.; Torres, O.; Chin, M.; [2002]; 25 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

Global distribution of aeolian dust is simulated from 1981 to 1996 with the Goddard Ozone Chemistry Aerosol Radiation and Transport (GOCART) model. The results are assessed with in-situ measurements and the Total Ozone Mapping Spectrometer (TOMS) aerosol products. The annual budget over the different continents and oceans are analyzed. It is found that there is a maximum of 25\% difference of global annual emission from the minimum in 1996 to the maximum in 1988. There is a downward trend of dust emission over Africa and East Asia, of 6 and 2 Tg/yr, respectively. The inter-annual variability of dust distribution is analyzed over the North Atlantic and Africa. It is found that in winter most of the North Atlantic and Africa dust loading is correlated with the North Atlantic Oscillation. The GOCART model indicates that a controlling factor of such correlation can be attributed to dust emission from the Sahel. The Bodele depression is the major dust source in winter and its inter-annual variability is highly correlated with the NAO. However, it is not possible to conclude without further analysis that the North Atlantic Oscillation is forcing the inter-annual variability of dust emission and in-turn dust concentration over the North Atlantic.
Author
Dust; Atlantic Ocean; Atmospheric Models

20030025225 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data

Bell, Thomas L.; Kundu, Prasun K.; [2002]; 1 pp.; In English; International Tropical Rainfall Measuring Mission Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

In spite of all their problems, rain gauges measure rainfall in such a direct way when compared with other methods of estimating rainfall that comparing their totals to satellite estimates remains an essential tool in the validation of satellite products. Some disagreement between averages of satellite data and rain-gauge data is expected because of the very different sampling patterns of the two systems--the satellite provides only occasional snapshots of large areas, whereas rain gauges provide continuous measurements over very small areas. A quantitative estimate of the expected level of disagreement due to the differences in sampling is needed in order for comparisons of the two kinds of averages to be informative. As part of an earlier effort to determine the sampling error of satellite averages, a space-time model for rainfall statistics was developed. Sets of parameter values for the model have been obtained for which the model statistics are found to agree quite well with those of radar data taken over the Atlantic during GATE and the western Pacific during TOGA COARE. Although the model was intended to represent the statistics of relatively large scale fluctuations of rain, it is surprisingly consistent with the very different scales on which rain gauges observe. Implications for maximizing the benefit in comparisons of rain gauge averages and TRMM estimates are derived using the model predictions.

Author

Trmm Satellite; Rain Gages; Estimating; Hydrology Models; Radar Measurement; Data Correlation

20030025226 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model

Iacovazzi, Robert A., Jr.; Prabhakara, C.; [2002]; 1 pp.; In English; International Tropical Rainfall Measuring Mission Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

In this study, a model is developed to estimate mesoscale-resolution atmospheric latent heating (ALH) profiles. It utilizes rain statistics deduced from Tropical Rainfall Measuring Mission (TRMM) data, and cloud vertical velocity profiles and regional surface thermodynamic climatologies derived from other available data sources. From several rain events observed over tropical ocean and land, ALH profiles retrieved by this model in convective rain regions reveal strong warming throughout most of the troposphere, while in stratiform rain regions they usually show slight cooling below the freezing level and significant warming above. The mesoscale-average, or total, ALH profiles reveal a dominant stratiform character, because stratiform rain areas are usually much larger than convective rain areas. Sensitivity tests of the model show that total ALH at a given tropospheric level varies by less than +/- 10 % when convective and stratiform rain rates and mesoscale fractional rain areas are perturbed individually by +/- 15 %. This is also found when the non-uniform convective vertical velocity profiles are replaced by one that is uniform. Larger variability of the total ALH profiles arises when climatological ocean- and land-surface temperatures (water vapor mixing ratios) are independently perturbed by +/- 1.0 K (+/- 5\%) and +/- 5.0 K (+/- 15\%), respectively. At a given tropospheric level, such perturbations can cause a +/- 25\% variation of total ALH over ocean, and a factor-of-two sensitivity over land. This sensitivity is reduced substantially if perturbations of surface thermodynamic variables do not change surface relative humidity, or are not extended throughout the entire model evaporation layer. The ALH profiles retrieved in this study agree qualitatively with tropical total diabatic heating profiles deduced in earlier studies. Also, from January and July 1999 ALH-profile climatologies generated separately with TRMM Microwave Imager and Precipitation Radar rain statistics, it is shown that ALH profiles can be retrieved utilizing diverse satellite-derived rain products that offer convective and stratiform discrimination. Therefore, the ALH retrieval model developed in this study can be used to make regional estimates of total diabatic heating profiles in the future Global Precipitation Measurement mission, and to assimilate these profiles into numerical weather forecast and climate models.

Author

Mesoscale Phenomena; Atmospheric Heating; Latent Heat; Rain; Atmospheric Models

20030025227 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Evaluation of Improvements to the TRMM Microwave Rain Algorithm

Yang, Song; Olson, Williams S.; Smith, Eric A.; Kummerow, Christian; [2002]; 1 pp.; In English; 1st TRMM International Science Conference, July 22-26, 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

Improvements made to the Version 5 TRMM passive microwave rain retrieval algorithm (2A-12) are evaluated using independent data. Surface rain rate estimates from the Version 5 TRMM TMI (2A-12), PR (2A-25) and TMI/PR Combined (2B-31) algorithms and ground-based radar estimates for selected coincident subset datasets in 1998 over Melbourne and

Kwajalein show varying degrees of agreement. The surface rain rates are then classified into convective and stratiform rain types over ocean, land, and coastal areas for more detailed comparisons to the ground radar measurements. These comparisons lead to a better understanding of the relative performances of the current TRMM rain algorithms. For example, at Melbourne more than 80\% of the radar-derived rainfall is classified as convective rain. Convective rain from the TRMM rain algorithms is less than that from ground radar measurements, while TRMM stratiform rain is much greater. Rain area coverage from 2A-12 is also in reasonable agreement with ground radar measurements, with about 25\% more over ocean and 25\% less over land and coastal areas. Retrieved rain rates from the improved (Version 6) 2A-12 algorithm will be compared to 2A-25, 2B-31, and ground-based radar measurements to evaluate the impact of improvements to 2A-12 in Version 6. An important improvement to the Version 6 2A-12 algorithm is the retrieval of Q1/Q2 (latent heating/drying) profiles in addition to the surface rain rate and hydrometeor profiles. In order to ascertain the credibility of the new products, retrieved Q1/Q2 profiles are compared to independent ground-based estimates. Analyses of dual-Doppler radar data in conjunction with coincident rawinsonde data yield estimates of the vertical distributions of diabatic heating/drying at high horizontal resolution for selected cases over the Kwajalein and LBA field sites. The estimated vertical heating/drying structures appear to be reasonable. Comparisons of Q1/Q2 profiles from Version 6 2A-12 and the ground-based estimates are in progress. Retrieved Q1/Q2 structures will also be compared to MM5 hurricane simulations for selected cases. The results of these intercomparisons will be presented at the conference.
Author
Algorithms; Meteorological Radar; Radar Measurement; Rain; Radar Data

20030025244 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Observational Evidence that Soil Moisture Variations Affect Precipitation
Koster, Randal D.; Suarez, Max J.; Higgins, R. Wayne; VandenDool, Huug M.; [2002]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Land-atmosphere feedback, by which precipitation-induced soil moisture anomalies affect subsequent precipitation, may be an important element of Earth's climate system, but its very existence has never been demonstrated conclusively at regional to continental scales. Evidence for the feedback is sought in a 50-year observational precipitation dataset covering the USA. The precipitation variance and autocorrelation fields are characterized by features that agree (in structure, though not in magnitude) with those produced by an atmospheric general circulation model (AGCM). Because the model-generated features are known to result from land-atmosphere feedback alone, the observed features are highly suggestive of the existence of feedback in nature.
Author
Soil Moisture; Precipitation (Meteorology); Climatology; Atmospheric General Circulation Models; Air Land Interactions

20030025274 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Overlap Properties of Clouds Generated by a Cloud Resolving Model
Oreopoulos, L.; Khairoutdinov, M.; December 2002; 22 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-11631; DE-AI02-00ER-62939; No Copyright; Avail: CASI; A03, Hardcopy

In order for General Circulation Models (GCMs), one of our most important tools to predict future climate, to correctly describe the propagation of solar and thermal radiation through the cloudy atmosphere a realistic description of the vertical distribution of cloud amount is needed. Actually, one needs not only the cloud amounts at different levels of the atmosphere, but also how these cloud amounts are related, in other words, how they overlap. Currently GCMs make some idealized assumptions about cloud overlap, for example that contiguous cloud layers overlap maximally and non-contiguous cloud layers overlap in a random fashion. Since there are difficulties in obtaining the vertical profile of cloud amount from observations, the realism of the overlap assumptions made in GCMs has not been yet rigorously investigated. Recently however, cloud observations from a relatively new type of ground radar have been used to examine the vertical distribution of cloudiness. These observations suggest that the GCM overlap assumptions are dubious. Our study uses cloud fields from sophisticated models dedicated to simulate cloud formation, maintenance, and dissipation called Cloud Resolving Models . These models are generally considered capable of producing realistic three-dimensional representation of cloudiness. Using numerous cloud fields produced by such a CRM we show that the degree of overlap between cloud layers is a function of their separation distance, and is in general described by a combination of the maximum and random overlap assumption, with random overlap dominating as separation distances increase. We show that it is possible to parameterize this behavior in a way that can eventually be incorporated in GCMs. Our results seem to have a significant resemblance to the results from the radar observations despite the completely different nature of the datasets. This consistency is encouraging and will promote

development of new radiative transfer codes that will estimate the radiation effects of multi-layer cloud fields more accurately.
Author
Atmospheric General Circulation Models; Clouds (Meteorology); Geophysics; Vertical Distribution; Parameterization; Cloud Physics

20030025276 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002
Demoz, Belay; Evans, Keith; DiGirolamo, Paolo; Wang, Zhe-In; Whiteman, David; Schwemmer, Geary; Gentry, Bruce; Miller, David; Palm, Stephen; [2002]; 5 pp.; In English; AMS 83rd Annual Meeting, 9-13 Feb. 2003, Long Beach, CA, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy

Variability in the convective boundary layer moisture, wind and temperature fields and their importance in the forecasting and understanding of storms have been discussed in the literature. These . variations have been reported in relation to frontal zones, stationary boundaries and during horizontal convective rolls. While all three vary substantially in the convective boundary layer, moisture poses a particular challenge. Moisture or water vapor concentration (expressed as a mass mixing ratio, g/kg), is conserved in all meteorological processes except condensation and evaporation. The water vapor mixing ratio often remains distinct across an air-mass boundary even when the temperature difference is indistinct. These properties make it an ideal choice in visualizing and understanding many of the atmosphere's dynamic features. However, it also presents a unique measurement challenge because water vapor content can vary by more than three orders of magnitude in the troposphere. Characterization of the 3D-distribution of water vapor is also difficult as water vapor observations can suffer from large sampling errors and substantial variability both in the vertical and horizontal. This study presents ground-based measurements of wind, boundary layer structure and water vapor mixing ratio measurements observed by three co-located lidars. This presentation will focus on the evolution and variability of moisture and wind in the boundary layer during a dry line event that occurred on 22 May 2002. These data sets and analyses are unique in that they combine simultaneous measurements of wind, moisture and CBL structure to study the detailed thermal variability in and around clear air updrafts during a dryline event. It will quantify the variation caused by, in and around buoyant plumes and across a dryline. The data presented here were collected in the panhandle of Oklahoma as part of the International H2O Project (MOP-2002), a field experiment that took place over the Southern Great Plains (SGP) of the USA from 13 May to 30 June 2002. The chief goal of MOP-2002 is to improve characterization of the four-dimensional (4-D) distribution of water vapor and its application to improving the understanding and prediction of convection
Author
Optical Radar; Wind (Meteorology); Radar Measurement; Moisture; Drying; Convection; Water Vapor

20030025277 Colorado Univ., Boulder, CO, USA
Space/Time Statistics of Polar Ice Motion
Emery, William J.; Fowler, Charles; Maslanik, James A.; [2003]; 1 pp.; In English
Contract(s)/Grant(s): NAG5-11559; No Copyright; Avail: CASI; A01, Hardcopy

Ice motions have been computed from passive microwave imagery (SMMR and SSM/I) on a daily basis for both Polar Regions. In the Arctic these daily motions have been merged with daily motions from AVHRR imagery and the Arctic buoy program. In the Antarctic motion only from the AVHRR were available for merging with the passive microwave vectors. Long-term means, monthly means and weekly means have all been computed from the resulting 22-year time series of polar ice motion. Papers are in preparation that present the long term (22 year) means, their variability and show animations of the monthly means over this time period for both Polar Regions. These papers will have links to 'enhanced objects' that allow the reader to view the animations as part of the paper. The first paper presents the ice motion results from each of the Polar Regions. The second paper looks only at ice motion in the Arctic in order to develop a time series of ice age in the Arctic. Starting with the first full SMMR year in 1979 we keep track of each individual 'ice element' (resolution of the sensor) and track it in the subsequent monthly time series. After a year we 'age' each 'particle' and we thus can keep track of the age of the ice starting in 1979. We keep track of ice age classes between one and five years and thus we can see the evolution of the ice as it ages after the initial 5-year period. This calculation shows how we are losing the older ice through Fram Strait at a rather alarming rate particularly in the past 15 years. This loss of older ice has resulted in an overall decrease in the thickest, oldest ice, which is now limited to a region just north of the Canadian Archipelago with tongues extending out across the pole towards the Siberian Shelf. This loss of old ice is consistent with the effects of global warming which provides the heat needed to melt, move and disperse this oldest ice through Fram Strait. This is the first step in a progression that may eventually open the Arctic ice pack and lead to an ice-free Arctic Ocean.
Author
Ice; Motion; Time Series Analysis; Polar Regions; Arctic Ocean

20030025287 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique

Ahn, C.; Ziemke, J. R.; Chandra, S.; Bhartia, P. K.; Journal of Atmospheric and Solar-Terrestrial Physics; [2002]; 29 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A recently developed technique called cloud slicing used for deriving upper tropospheric ozone from the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) instrument combined together with temperature-humidity and infrared radiometer (THIR) is no longer applicable to the Earth Probe TOMS (EPTOMS) because EPTOMS does not have an instrument to measure cloud top temperatures. For continuing monitoring of tropospheric ozone between 200-500hPa and testing the feasibility of this technique across spacecrafts, EPTOMS data are co-located in time and space with the Geostationary Operational Environmental Satellite (GOES)-8 infrared data for 2001 and early 2002, covering most of North and South America (45S-45N and 120W-30W). The maximum column amounts for the mid-latitudinal sites of the northern hemisphere are found in the March-May season. For the mid-latitudinal sites of the southern hemisphere, the highest column amounts are found in the September-November season, although overall seasonal variability is smaller than those of the northern hemisphere. The tropical sites show the weakest seasonal variability compared to higher latitudes. The derived results for selected sites are cross validated qualitatively with the seasonality of ozonesonde observations and the results from THIR analyses over the 1979-1984 time period due to the lack of available ozonesonde measurements to study sites for 2001. These comparisons show a reasonably good agreement among THIR, ozonesonde observations, and cloud slicing-derived column ozone. With very limited co-located EPTOMS/GOES data sets, the cloud slicing technique is still viable to derive the upper tropospheric column ozone. Two new variant approaches, High-Low (HL) cloud slicing and ozone profile derivation from cloud slicing are introduced to estimate column ozone amounts using the entire cloud information in the troposphere.
Author

Goes Satellites; Ozone; Total Ozone Mapping Spectrometer; Troposphere; Clouds (Meteorology); Meteorological Parameters

20030025288 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002

Demoz, Belay; Evans, Keith; DiGirolamo, Paolo; Wang, Zhien; Whiteman, David; Schwemmer, Geary; Gentry, Bruce; Miller, David; [2003]; 5 pp.; In English; AMS Conference, 9-13 Feb, 2003, Long Beach, CA, USA; Copyright; Avail: CASI; A01, Hardcopy

Variability in the convective boundary layer moisture, wind and temperature fields and their importance in the forecasting and understanding of storms have been discussed in the literature. These variations have been reported in relation to frontal zones, stationary boundaries and during horizontal convective rolls. While all three vary substantially in the convective boundary layer, moisture poses a particular challenge. Moisture or water vapor concentration (expressed as a mass mixing ratio, g/kg), is conserved in all meteorological processes except condensation and evaporation. The water vapor mixing ratio often remains distinct across an air -mass boundary even when the temperature difference is indistinct. These properties make it an ideal choice in visualizing and understanding many of the atmosphere's dynamic features. However, it also presents a unique measurement challenge because water vapor content can vary by more than three orders of magnitude in the troposphere. Characterization of the 3D-distribution of water vapor is also difficult as water vapor observations can suffer from large sampling errors and substantial variability both in the vertical and horizontal. This study presents groundbased measurements of wind, boundary layer structure and water vapor mixing ratio measurements observed by three co-located lidars. This presentation will focus on the evolution and variability of moisture and wind in the boundary layer during a dry line event that occurred on 22 May 2002. These data sets and analyses are unique in that they combine simultaneous measurements of wind, moisture and CBL structure to study the detailed thermal variability in and around clear air updrafts during a dryline event. It will quantify the variation caused by, in and around buoyant plumes and across a dryline. The data presented here were collected in the panhandle of Oklahoma as part of the International BO Project (IHOP-2002), a field experiment that took place over the Southern Great Plains (SGP) of the USA from 13 May to 30 June 2002. The chief goal of IHOP-2002 is to improve characterization of the four-dimensional (4-D) distribution of water vapor and its application to improving the understanding and prediction of convection
Author

Optical Radar; Wind Measurement; Moisture; Boundary Layer Control; Forecasting; Radar Measurement; Evaporation

20030025289 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Assessing Impacts of Global Warming on Tropical Cyclone Tracks

Wu, Li-Guang; Wang, Bin; Journal of Climate; [2003]; 43 pp.; In English
Contract(s)/Grant(s): N00014-021-0532; Copyright; Avail: CASI; A03, Hardcopy

A new approach is proposed to assess the possible impacts of the global climate change on tropical cyclone (TC) tracks in the western North Pacific (WNP) basin. The idea is based on the premise that the future change of TC track characteristics is primarily determined by changes in large-scale environmental steering flows. It is demonstrated that the main characteristics of the current climatology of TC tracks can be derived from the climatological mean velocity field of TC motion by using a trajectory model. The climatological mean velocity of TC motion, which is composed of the large-scale steering and beta drift, is determined on each grid of the basin. The mean beta drift is estimated from the best track data, and the mean large-scale steering flow is computed from the NCEP/NCAR reanalysis for the current climate state. The derived mean beta drift agrees well with the results of previous observational and numerical studies in terms of its direction and magnitude. The outputs of experiments A2 and B2 of the Geophysical Fluid Dynamics Laboratory (GFDL) R30 climate model suggest that the subtropical high will be persistently weak over the western part of the WNP or shift eastward during July-September in response to the future climate change. By assuming that the mean beta drift in the future climate state is unchanged, the change in the general circulation by 2059 will decrease the TC activities in the WNP, but favor a northward shift of typical TC tracks. As a result, the storm activities in the South China Sea will decrease by about 12\%, while the Japan region will experience an increase of TCs by 12-15\%. During the period of 2000-2029, the tropical storms that affect the China region will increase by 5-6\%, but return to the current level during 2030-2059. It is also suggested that, during the period of 2030-2059 tropical storms will more frequently affect Japan and the middle latitude region of China given that the formation locations remain the same as in the current climate state.
Author
Cyclones; Global Warming; Tropical Storms; Climatology; Geophysics; Climate Models

20030025291 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The SPARC Intercomparison of Middle Atmosphere Climatologies
Randel, William; Fleming, Eric; Geller, Marvin; Gelman, Mel; Hamilton, Kevin; Karoly, David; Ortland, Dave; Pawson, Steve; Swinbank, Richard; Udelhofen, Petra; Journal of Climate; January 2003; 60 pp.; In English; Copyright; Avail: CASI; A04, Hardcopy

Our current confidence in 'observed' climatological winds and temperatures in the middle atmosphere (over altitudes approx. 10-80 km) is assessed by detailed intercomparisons of contemporary and historic data sets. These data sets include global meteorological analyses and assimilations, climatologies derived from research satellite measurements, and historical reference atmosphere circulation statistics. We also include comparisons with historical rocketsonde wind and temperature data, and with more recent lidar temperature measurements. The comparisons focus on a few basic circulation statistics, such as temperature, zonal wind, and eddy flux statistics. Special attention is focused on tropical winds and temperatures, where large differences exist among separate analyses. Assimilated data sets provide the most realistic tropical variability, but substantial differences exist among current schemes.
Author
Climatology; Wind (Meteorology); Atmospheric Temperature; Middle Atmosphere; Atmospheric Circulation

20030025294 NASA Goddard Space Flight Center, Greenbelt, MD, USA
NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future
Shepherd, J. Marshall; Herring, David; Gutro, Rob; Huffman, George; Halverson, Jeff; [2002]; 27 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

Weatherwise is probably the most popular newstand magazine focusing on the subject of weather. It is published six times per year and includes features on weather, climate, and technology. This article (to appear in the January/February Issue) provides a comprehensive review of NASA s past, present, and future contributions in satellite remote sensing for weather and climate processes. The article spans the historical strides of the TIROS program through the scientific and technological innovation of Earth Observer-3 and Global Precipitation Measurement (GPM). It is one of the most thorough reviews of NASA s weather and climate satellite efforts to appear in the popular literature.
Author
Climate; Weather; Meteorological Satellites; NASA Programs; Precipitation (Meteorology)

20030025346 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite
Habib, Shahid; Makridenko, L.; Chu, W.; Salikhov, R.; Moore, A.; Trepte, C.; Cisewski, M.; [2002]; 1 pp.; In English; SPIE Remote Sensing Symposium, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

Under a joint agreement between the National Aeronautics and Space Agency (NASA) and the Russian Aviation and Space Agency (RASA), the Stratospheric Aerosol Gas Experiment III (SAGE III) instrument was launched in low earth orbit on December 10,2001 aboard the Russian Meteor-3M satellite from the Baikonur Cosmodrome. SAGE III is a spectrometer that measures attenuated radiation in the 282 nm to 1550 nm wavelength range to obtain the vertical profiles of ozone, aerosols, and other chemical species that are critical in studying the trends for the global climate change phenomena. This instrument version is more advanced than any of the previous versions and has more spectral bands, elaborate data gathering and storage, and intelligent terrestrial software. There are a number of Russian scientific instruments aboard the Meteor satellite in addition to the SAGE III instrument. These instruments deal with land imaging and biomass changes, hydro-meteorological monitoring, and helio-geophysical research. This mission was under development for over a period of six years and offered a number of unique technical and program management challenges for both Agencies. SAGE III has a long space heritage, and four earlier versions of this instrument have flown in space for nearly two decades now. In fact, SAGE II, the fourth instrument, is still flying in space on NASA s Earth Radiation Budget Satellite (ERBS), and has been providing important atmospheric data over the last 18 years. It has provided vital ozone and aerosol data in the mid latitudes and has contributed vastly in ozone depletion research. Ball Aerospace built the instrument under Langley Research Center s (LaRC) management. This paper presents innovative approaches deployed by the SAGE III and the Meteor teams in performing the initial on-orbit checkout. It further documents a number of early science results obtained by deploying low risk, carefully coordinated procedures in resolving the serious operational issues of this satellite.
Author
Climate Change; Imaging Techniques; Aerosols; Climatology; Stratosphere

20030025350 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A New Look into the Effect of Large Drops on Radiative Transfer Process
Marshak, Alexander; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Recent studies indicate that a cloudy atmosphere absorbs more solar radiation than any current 1D or 3D radiation model can predict. The excess absorption is not large, perhaps 10-15 W/sq m or less, but any such systematic bias is of concern since radiative transfer models are assumed to be sufficiently accurate for remote sensing applications and climate modeling. The most natural explanation would be that models do not capture real 3D cloud structure and, as a consequence, their photon path lengths are too short. However, extensive calculations, using increasingly realistic 3D cloud structures, failed to produce photon paths long enough to explain the excess absorption. Other possible explanations have also been unsuccessful so, at this point, conventional models seem to offer no solution to this puzzle. The weakest link in conventional models is the way a size distribution of cloud particles is mathematically handled. Basically, real particles are replaced with a single average particle. This 'ensemble assumption' assumes that all particle sizes are well represented in any given elementary volume. But the concentration of larger particles can be so low that this assumption is significantly violated. We show how a different mathematical route, using the concept of a cumulative distribution, avoids the ensemble assumption. The cumulative distribution has jumps, or steps, corresponding to the rarer sizes. These jumps result in an additional term, a kind of Green's function, in the solution of the radiative transfer equation. Solving the cloud radiative transfer equation with the measured particle distributions, described in a cumulative rather than an ensemble fashion, may lead to increased cloud absorption of the magnitude observed.
Author
Radiative Transfer; Climate Models; Cloud Physics; Solar Radiation

20030025354 NASA Goddard Space Flight Center, Greenbelt, MD, USA
MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol
Kaufman, Yoram; Chin, Mian; Remer, Lorraine; Tanre, Didier; Lau, William K.-M., Technical Monitor; [2003]; 1 pp.; In English; Harvard University Conference, 31 Jan. - 1 Feb. 2003, Cambridge, MA, USA; No Copyright; Avail: Other Sources; Abstract Only

Recently produced daily MODIS aerosol data for the whole year of 2001 are used to show the concentration and dynamics of aerosol over ocean and large parts of the continents. The data were validated against the Aerosol Robotic Network (AERONET) measurements over land and ocean. Monthly averages and a movie based on the daily data are produced and used to demonstrate the spatial and temporal evolution of aerosol. The MODIS wide spectral range is used to distinguish fine smoke and pollution aerosol from coarse dust and salt. The aerosol is observed above ocean and land. The movie produced from the MODIS data provides a new dimension to aerosol observations by showing the dynamics of the system. For example in February smoke and dust emitted from the Sahel and West Africa is shown to travel to the North-East Atlantic. In April heavy dust and pollution from East Asia is shown to travel to North America. In May-June pollution and dust play a dynamical

dance in the Arabian Sea and Bay of Bengal. In Aug-September smoke from South Africa and South America is shown to pulsate in tandem and to periodically to be transported to the otherwise pristine Southern part of the Southern Hemisphere. The MODIS data are compared with the GOCART model and used to estimate the first observation based direct anthropogenic radiative forcing of climate by aerosol.
Author
Aerosols; Ocean Dynamics; Climate; Imaging Spectrometers

20030025370 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Multispectral Cloud Retrievals from MODIS on Terra and Aqua
King, Michael D.; Platnick, Steven; Ackerman, Steven A.; Menzel, W. Paul; Gray, Mark A.; Moody, Eric G.; [2002]; 1 pp.; In English; SPIE 2002: Optical Remote Sensing of the Atmosphere and Clouds III, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

The Moderate Resolution Imaging Spectroradiometer (MODIS) was developed by NASA and launched onboard the Terra spacecraft on December 18, 1999 and the Aqua spacecraft on April 26, 2002. MODIS scans a swath width sufficient to provide nearly complete global coverage every two days from each polar-orbiting, sun-synchronous, platform at an altitude of 705 km, and provides images in 36 spectral bands between 0.415 and 14.235 microns with spatial resolutions of 250 m (2 bands), 500 m (5 bands) and 1000 m (29 bands). In this paper we will describe the various methods being used for the remote sensing of cloud properties using MODIS data, focusing primarily on the MODIS cloud mask used to distinguish clouds, clear sky, heavy aerosol, and shadows on the ground, and on the remote sensing of cloud optical properties, especially cloud optical thickness and effective radius of water drops and ice crystals. Additional properties of clouds derived from multispectral thermal infrared measurements, especially cloud top pressure and emissivity, will also be described. Results will be presented of MODIS cloud properties both over the land and over the ocean, showing the consistency in cloud retrievals over various ecosystems used in the retrievals. The implications of this new observing system on global analysis of the Earth's environment will be discussed.
Author
Imaging Spectrometers; Cloud Physics; Remote Sensing; Optical Thickness; Aerosols; Systems Analysis

20030025399 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information
Adler, Robert F.; Huffman, George; Curtis, Scott; Bolvin, David; Nelkin, Eric; [2002]; 1 pp.; In English; SPIE Remote Sensing Symposium, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

Global precipitation analysis covering the last few decades and the impact of the new TRMM precipitation observations are discussed. The 20+ year, monthly, globally complete precipitation analysis of the World Climate Research Program's (WCRP/GEWEX) Global Precipitation Climatology Project (GPCP) is used to explore global and regional variations and trends and is compared to the much shorter TRMM(Tropical Rainfall Measuring Mission) tropical data set. The GPCP data set shows no significant trend in precipitation over the twenty years, unlike the positive trend in global surface temperatures over the past century. Regional trends are also analyzed. A trend pattern that is a combination of both El Nino and La Nina precipitation features is evident in the 20-year data set. This pattern is related to an increase with time in the number of combined months of El Nino and La Nina during the 20 year period. Monthly anomalies of precipitation are related to ENS0 variations with clear signals extending into middle and high latitudes of both hemispheres. The GPCP daily, 1 deg. latitude-longitude analysis, which is available from January 1997 to the present is described and the evolution of precipitation patterns on this time scale related to El Nino and La Nina is discussed. Finally, a TRMM-based 3-hr analysis is described that uses TRMM to calibrate polar-orbit microwave observations from SSM/I and geosynchronous IR observations and merges the various calibrated observations into a final, 3-hr resolution map. This TRMM standard product will be available for the entire TRMM period (January 1998-present). A real-time version of this merged product is being produced and is available at 0.25 deg. latitude-longitude resolution over the latitude range from 5O deg. N-50 deg. S. Examples are shown, including its use in monitoring flood conditions.
Author
Precipitation (Meteorology); Climatology; Information Analysis; Trmm Satellite; Annual Variations

20030025400 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective
Lau, William K. M., Technical Monitor; Tsay, Si-Chee; Hsu, N. Christina; Herman, Jay R.; Ji, Q. Jack; [2002]; 1 pp.; In

English; Sino-US Workshop on Dust Storms and Their Effect on Human Health, 25-26 Nov. 2002, Raleigh, NC, USA; No Copyright; Avail: Other Sources; Abstract Only

Many recent field experiments are designed to study the compelling variability in spatial and temporal scale of both pollution-derived and naturally occurring aerosols, which often exist in high concentration over particular pathways around the globe. For example, the ACE-Asia (Aerosol Characterization Experiment-Asia) was conducted from March-May 2001 in the vicinity of the Taklimakan and Gobi deserts, East Coast of China, Yellow Sea, Korea, and Japan, along the pathway of Kosa (severe events that blanket East Asia with yellow desert dust, peaked in the Spring season). The PRIDE (Puerto RIco Dust Experiment, July 2000) was designed to measure the properties of Saharan dust transported across the Atlantic Ocean to the Caribbean. Dust particles typically originate in desert areas far from polluted urban regions. During transport, dust layers can interact with anthropogenic sulfate and soot aerosols from heavily polluted urban areas. Added to the complex effects of clouds and natural marine aerosols, dust particles reaching the marine environment can have drastically different properties than those from the source. Thus, understanding the unique temporal and spatial variations of dust aerosols is of special importance in regional-to-global climate issues such as radiative forcing, the hydrological cycle, and primary biological productivity in the ocean. During ACE-Asia and PRIDE we had measured aerosol physical/optical/radiative properties, column precipitable water amount, and surface reflectivity over homogeneous areas from ground-based remote sensing. The inclusion of flux measurements permits the determination of aerosol radiative flux in addition to measurements of loading and optical depth. At the time of the Terra/MODIS, SeaWiFS, TOMS and other satellite overpasses, these ground-based observations can provide valuable data to compare with satellite retrievals over land. We will present the results and discuss their implications in regional climatic effects.

Author

Dust; Aerosols; Pollution; Temporal Distribution; Hydrological Cycle; Imaging Spectrometers

20030025444 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra

Atlas, Robert, Technical Monitor; Joiner, Joanna; Vasikov, Alexander; Flittner, David; Gleason, James; Bhartia, P. K.; [2002]; 45 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Reliable cloud pressure estimates are needed for accurate retrieval of ozone and other trace gases using satellite-borne backscatter ultraviolet (buv) instruments such as the global ozone monitoring experiment (GOME). Cloud pressure can be derived from buv instruments by utilizing the properties of rotational-Raman scattering (RRS) and absorption by O2-O2. In this paper we estimate cloud pressure from GOME observations in the 355-400 nm spectral range using the concept of a Lambertian-equivalent reflectivity (LER) surface. GOME has full spectral coverage in this range at relatively high spectral resolution with a very high signal-to-noise ratio. This allows for much more accurate estimates of cloud pressure than were possible with its predecessors SBUV and TOMS. We also demonstrate the potential capability to retrieve chlorophyll content with full-spectral buv instruments. We compare our retrieved LER cloud pressure with cloud top pressures derived from the infrared ATSR instrument on the same satellite. The findings confirm results from previous studies that showed retrieved LER cloud pressures from buv observations are systematically higher than IR-derived cloud-top pressure. Simulations using Mie-scattering radiative transfer algorithms that include O2-O2 absorption and RRS show that these differences can be explained by increased photon path length within and below cloud.

Author

Chlorophylls; Clouds (Meteorology); Raman Spectra; Solar Backscatter Uv Spectrometer; Ultraviolet Spectra; Mie Scattering; Ozone

20030025445 Meteorological Satellite Center, Kiyose, Japan

Monthly Report of the Meteorological Satellite Center: December 2002

December 2002; In English; The CD-ROM conforms to the ISO 9660 standard for volume and file structure; Document files and Satellite observation data are recorded in either in ASCII or shift JIS code; Full Disk Earth's Cloud Images are recored in Bit-Map (BMP) format; Copyright; Avail: Other Sources

The CD-ROM concerning the December 2002 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth's Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS

Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.
Derived from text
Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan

20030025673 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations
Oltmans, S. J.; Johnson, B. J.; Harris, J. M.; Thompson, A. M.; Liu, H. Y.; Voemel, H.; Chan, C. Y.; Fujimoto, T.; Brackett, V. G.; Chang, W. L.; January 2003; 64 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A04, Hardcopy

As part of the TRACE-P mission, ozone vertical profile measurements were made at a number of locations in the North Pacific. At most of the sites there is also a multi-year record of ozonesonde observations. From seven locations in the western Pacific (Hong Kong; Taipei; Jeju Island, Korea; and Naha, Kagoshima, Tsukuba, and Sapporo, Japan), a site in the central Pacific (Hilo, HI), and a site on the west coast of the U.S. (Trinidad Head, CA) both a seasonal and event specific picture of tropospheric ozone over the North Pacific emerges. At all of the sites there is a pronounced spring maximum through the troposphere. There are, however, differences in the timing and strength of this feature. Over Japan the northward movement of the jet during the spring and summer influences the timing of the seasonal maximum. The ozone profiles suggest that transport of ozone rich air from the stratosphere plays a strong role in the development of this maximum. During March and April at Hong Kong ozone is enhanced in a layer that extends from the lower free troposphere into the upper troposphere that likely has its origin in biomass burning in northern Southeast Asia and equatorial Africa. During the winter the Pacific subtropical sites (latitude -25N) are dominated by air with a low-latitude, marine source that gives low ozone amounts particularly in the upper troposphere. In the summer in the boundary layer at all of the sites marine air dominates and ozone amounts are generally quite low (less than 25 ppb). The exception is near large population centers (Tokyo and Taipei but not Hong Kong) where pollution events can give amounts in excess of 80 ppb. During the TRACE-P intensive campaign period (February-April 2001) tropospheric ozone amounts were rather typical of those seen in the long-term records of the stations with multi-year soundings.
Author
Atmospheric Sounding; Ozonometry; Troposphere; Pacific Ocean

20030025679 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002.
Otterman, J.; Starr, D. OC.; Atlas, R.; Jusem, J. C.; Saaroni, H.; January 2003; 17 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

To assess interannual changes in ocean-to-land advection, we extract zonal winds for February and March, 1949-2002, from NCEP/NCAR Reanalysis. Winds are analyzed at pairs of locations (55 deg N and 35 deg N) in the N. Pacific (15 deg W), N. Atlantic (30 deg W) and Baltic/Mediterranean (30 deg E). The monthly means at the northern and southern sites are negatively correlated. For N. Pacific, winds at 55 deg N show negative trends at all levels (magnitude increasing with altitude), versus positive at 35 deg N. An opposite scenario is observed over N. Atlantic, positive (negative) trends at 55 deg N (35 deg N) and similarly, but weaker, over the Baltic/Mediterranean. The geographic variability of trends is attributed to displacement of the polar vortex wave pattern. Increasing storm strength/frequency over N. Hemisphere oceans is inherently related to the strong positive trends in wind speed and vertical shear.
Author
Northern Hemisphere; Trends; Oceans; Winter; Atmospheric Circulation; Advection

20030025695 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN)
Shepherd, J. Marshall; Taylor, Layi; [2003]; 30 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

NASA satellites and ground instruments have indicated that cities like Atlanta, Georgia may create or alter rainfall. Scientists speculate that the urban heat island caused by man-made surfaces in cities impact the heat and wind patterns that form clouds and rainfall. However, more conclusive evidence is required to substantiate findings from satellites. NASA, along with scientists at Clark Atlanta University, are implementing a dense, urban rain gauge network in the metropolitan Atlanta area to support a satellite validation program called Studies of PRecipitation Anomalies from Widespread Urban Landuse (SPRAWL). SPRAWL will be conducted during the summer of 2003 to further identify and understand the impact of urban

Atlanta on precipitation variability. The paper provides an. overview of SPRAWL, which represents one of the more comprehensive efforts in recent years to focus exclusively on urban-impacted rainfall. The paper also introduces a novel technique for deploying rain gauges for SPRAWL. The deployment of the dense Atlanta network is unique because it utilizes Geographic Information Systems (GIS) and Decision Support Systems (DSS) to optimize deployment of the rain gauges. These computer aided systems consider access to roads, drainage systems, tree cover, and other factors in guiding the deployment of the gauge network. GIS and DSS also provide decision-makers with additional resources and flexibility to make informed decisions while considering numerous factors. Also, the new Atlanta network and SPRAWL provide a unique opportunity to merge the high-resolution, urban rain gauge network with satellite-derived rainfall products to understand how cities are changing rainfall patterns, and possibly climate.
Author
Cities; Climate; Heat Islands; Rain; Rain Gages; Environment Effects; Urban Development

20030025710 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations
Choudhury, Bhaskar J.; Quick, B. E.; [2003]; 1 pp.; In English; Data for Environmental and Global Change: 54th International Astronautical Congress, 29 Sep. - 3 Oct. 2003, Bremen, Germany; No Copyright; Avail: Other Sources; Abstract Only

Structure and function of terrestrial plant communities bring about intimate relations between water, energy, and carbon exchange between land surface and atmosphere. Total evaporation, which is the sum of transpiration, soil evaporation and evaporation of intercepted water, couples water and energy balance equations. The rate of transpiration, which is the major fraction of total evaporation over most of the terrestrial land surface, is linked to the rate of carbon accumulation because functioning of stomata is optimized by both of these processes. Thus, quantifying the spatial and temporal variations of the transpiration efficiency (which is defined as the ratio of the rate of carbon accumulation and transpiration), and water use efficiency (defined as the ratio of the rate of carbon accumulation and total evaporation), and evaluation of modeling results against observations, are of significant importance in developing a better understanding of land surface processes. An approach has been developed for quantifying spatial and temporal variations of transpiration, and water-use efficiency based on biophysical process-based models, satellite and field observations. Calculations have been done using concurrent meteorological data derived from satellite observations and four dimensional data assimilation for four consecutive years (1987-1990) over an agricultural area in the Northern Great Plains of the US, and compared with field observations within and outside the study area. The paper provides substantive new information about interannual variation, particularly the effect of drought, on the efficiency values at a regional scale.
Author
Water Balance; Hydrological Cycle; Hydrology Models; Transpiration; Energy Budgets; Agrometeorology; Hydrometeorology; Evaporation Rate

20030025717 NASA Goddard Space Flight Center, Greenbelt, MD, USA Science Applications International Corp., Greenbelt, MD, USA
Large 0/12 GMT Differences of US Vaisala RS80 Observations
Atlas, Robert, Technical Monitor; [2002]; 7 pp.; In English; Radiosonde Workshop, 21-23 May 2002, Hampton, VA, USA; No Copyright; Avail: CASI; A02, Hardcopy

Large differences been observations taken at 0 and 12 GMT have been revealed during routine monitoring of observations at the Data Assimilation Office (DAO) at NASA's Goddard Space Flight Center (GSFC). As a result, an investigation has been conducted to confirm the large differences and isolate its source. The data clearly shows that 0/12 GMT differences are largely artificial especially over the central US and that the differences largely originate in the post processing software at the observing stations. In particular, the release time of the rawinsonde balloon may be misspecified to be the synoptic time which would lead to the miscalculation of the bias correction that accounts for solar radiation effects on the thermistor.
Author
Bias; Meteorological Balloons; Rawinsondes; Errors; Temperature Measurement; Altitude

20030025758 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS
King, Michael D.; Menzel, W. Paul; Kaufman, Yoram J.; Tanre, Didier; Gao, Bo-Cai; Platnick, Steven; Ackerman, Steven A.; Remer, Lorraine A.; Pincus, Robert; Hubanks, Paul A.; [2003]; 47 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy

The Moderate Resolution Imaging Spectroradiometer (MODIS) is an earth-viewing sensor that flies on the Earth Observing System (EOS) Terra and Aqua satellites, launched in 1999 and 2002, respectively. MODIS scans a swath width of 2330 km that is sufficiently wide to provide nearly complete global coverage every two days from a polar-orbiting, sun-synchronous, platform at an altitude of 705 km. MODIS provides images in 36 spectral bands between 0.415 and 14.235 pm with spatial resolutions of 250 m (2 bands), 500 m (5 bands) and 1000 m (29 bands). These bands have been carefully selected to en- able advanced studies of land, ocean, and atmospheric properties. Twenty-six bands are used to derive atmospheric properties such as cloud mask, atmospheric profiles, aerosol properties, total precipitable water, and cloud properties. In this paper we describe each of these atmospheric data products, including characteristics of each of these products such as file size, spatial resolution used in producing the product, and data availability.
Author
Earth Observing System (Eos); Aerosols; Cloud Physics; Water Vapor; Meteorological Parameters; Imaging Spectrometers

20030025767 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Classification of Mediterranean Cyclones Based on Global Analyses
Reale, Oreste; Atlas, Robert; [2003]; 49 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The Mediterranean Sea region is dominated by baroclinic and orographic cyclogenesis. However, previous work has demonstrated the existence of rare but intense subsynoptic-scale cyclones displaying remarkable similarities to tropical cyclones and polar lows, including, but not limited to, an eye-like feature in the satellite imagery. The terms polar low and tropical cyclone have been often used interchangeably when referring to small-scale, convective Mediterranean vortices and no definitive statement has been made so far on their nature, be it sub-tropical or polar. Moreover, most of the classifications of Mediterranean cyclones have neglected the small-scale convective vortices, focusing only on the larger-scale and far more common baroclinic cyclones. A classification of all Mediterranean cyclones based on operational global analyses is proposed The classification is based on normalized horizontal shear, vertical shear, scale, low versus mid-level vorticity, low-level temperature gradients, and sea surface temperatures. In the classification system there is a continuum of possible events, according to the increasing role of barotropic instability and decreasing role of baroclinic instability. One of the main results is that the Mediterranean tropical cyclone-like vortices and the Mediterranean polar lows appear to be different types of events, in spite of the apparent similarity of their satellite imagery. A consistent terminology is adopted, stating that tropical cyclone-like vortices are the less baroclinic of all, followed by polar lows, cold small-scale cyclones and finally baroclinic lee cyclones. This classification is based on all the cyclones which occurred in a four-year period (between 1996 and 1999). Four cyclones, selected among all the ones which developed during this time-frame, are analyzed. Particularly, the classification allows to discriminate between two cyclones (occurred in October 1996 and in March 1999) which both display a very well-defined eye-like feature in the satellite imagery. According to our classification system, the two events are dynamically different and can be categorized as being respectively a tropical cyclone-like vortex and well-developed polar low.
Author
Cyclones; Mediterranean Sea; Meteorology; Cyclogenesis; Classifications

20030025770 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2)
Chou, Shu-Hsien; Nelkin, Eric; Ardizzone, Joe; Atlas, Robert M.; Shie, Chung-Lin; Starr, David O'C., Technical Monitor; October 22, 2002; 41 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Information on the turbulent fluxes of momentum, moisture, and heat at the air-sea interface is essential in improving model simulations of climate variations and in climate studies. We have derived a 13.5-year (July 1987-December 2000) dataset of daily surface turbulent fluxes over global oceans from the Special Sensor Mcrowave/Imager (SSM/I) radiance measurements. This dataset, version 2 Goddard Satellite-based Surface Turbulent Fluxes (GSSTF2), has a spatial resolution of 1 degree x 1 degree latitude-longitude and a temporal resolution of 1 day. Turbulent fluxes are derived from the SSM/I surface winds and surface air humidity, as well as the 2-m air and sea surface temperatures (SST) of the NCEP/NCAR reanalysis, using a bulk aerodynamic algorithm based on the surface layer similarity theory.
Derived from text
Turbulence; Climatology; Ocean Models; Remote Sensing; Heat Flux; Satellite Imagery

20030025774 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate

Lau, William K. M.; October 2002; 47 pp.; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

This is an invited review paper intended to be published as a Chapter in a book entitled 'The Global Climate System: Patterns, Processes and Teleconnections' Cambridge University Press. The author begins with an introduction followed by a primer of climate models, including a description of various modeling strategies and methodologies used for climate diagnostics and predictability studies. Results from the CLIVAR Monsoon Model Intercomparison Project (MMIP) were used to illustrate the application of the strategies to modeling the Asian monsoon. It is shown that state-of-the art atmospheric GCMs have reasonable capability in simulating the seasonal mean large scale monsoon circulation, and response to El Nino. However, most models fail to capture the climatological as well as interannual anomalies of regional scale features of the Asian monsoon. These include in general over-estimating the intensity and/or misplacing the locations of the monsoon convection over the Bay of Bengal, and the zones of heavy rainfall near steep topography of the Indian subcontinent, Indonesia, and Indo-China and the Philippines. The intensity of convection in the equatorial Indian Ocean is generally weaker in models compared to observations. Most important, an endemic problem in all models is the weakness and the lack of definition of the Mei-yu rainbelt of the East Asia, in particular the part of the Mei-yu rainbelt over the East China Sea and southern Japan are under-represented. All models seem to possess certain amount of intraseasonal variability, but the monsoon transitions, such as the onset and breaks are less defined compared with the observed. Evidences are provided that a better simulation of the annual cycle and intraseasonal variability is a pre-requisite for better simulation and better prediction of interannual anomalies.

Author

Climatology; Climate Models; Monsoons; Asia; Anomalies

20030031337 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations

Tao, W.-K.; Shie, C.-H.; Simpson, J.; Starr, D.; Johnson, D.; Sud, Y.; [2003]; 1 pp.; In English; 13th ARM Program Science Team Meeting, 31 Mar. - 4 Apr. 2003, Broomfield, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

Real clouds and clouds systems are inherently three dimensional (3D). Because of the limitations in computer resources, however, most cloud-resolving models (CRMs) today are still two-dimensional (2D). A few 3D CRMs have been used to study the response of clouds to large-scale forcing. In these 3D simulations, the model domain was small, and the integration time was 6 hours. Only recently have 3D experiments been performed for multi-day periods for tropical cloud system with large horizontal domains at the National Center for Atmospheric Research. The results indicate that surface precipitation and latent heating profiles are very similar between the 2D and 3D simulations of these same cases. The reason for the strong similarity between the 2D and 3D CRM simulations is that the observed large-scale advective tendencies of potential temperature, water vapor mixing ratio, and horizontal momentum were used as the main forcing in both the 2D and 3D models. Interestingly, the 2D and 3D versions of the CRM used in CSU and U.K. Met Office showed significant differences in the rainfall and cloud statistics for three ARM cases. The major objectives of this project are to calculate and axamine: (1)the surface energy and water budgets, (2) the precipitation processes in the convective and stratiform regions, (3) the cloud upward and downward mass fluxes in the convective and stratiform regions; (4) cloud characteristics such as size, updraft intensity and lifetime, and (5) the entrainment and detrainment rates associated with clouds and cloud systems that developed in TOGA COARE, GATE, SCSMEX, ARM and KWAJEX. Of special note is that the analyzed (model generated) data sets are all produced by the same current version of the GCE model, i.e. consistent model physics and configurations. Trajectory analyse and inert tracer calculation will be conducted to identify the differences and similarities in the organization of convection between simulated 2D and 3D cloud systems.

Author

Rain; Water Vapor; Water Balance; Two Dimensional Models; Three Dimensional Models; Surface Energy; Simulation; Cumulus Clouds; Advection

20030031347 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Causes of Long-Term Drought in the USA Great Plains

Schubert, Siegfried D.; Suarez, Max J.; Pegion, Philip J.; Koster, Randal; July 03, 2002; 45 pp.; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The USA Great Plains (USGP) experienced a number of multi-year droughts during the last century, most notably the

droughts of the 1930s and 1950s. This study examines the causes of such droughts using ensembles of long term (1930-1999) simulations carried out with the NASA Seasonal-to-Interannual Prediction Project (NSIPP-1) atmospheric general circulation model (AGCM) forced with observed sea surface temperatures (SSTs). The results show that the model produces long-term (multi-year) variations in the USGP precipitation that are similar to those observed. A correlative analysis suggests that the ensemble mean low frequency (time scales longer than about 6 years) rainfall variations in the USGP are linked to a pan-Pacific pattern of SST variability that is the leading empirical orthogonal function (EOF) in the low frequency SST data. The link between the SST and the Great Plains precipitation is confirmed in idealized AGCM simulations, in which the model is forced by the 2 polarities of the pan-Pacific SST pattern. The idealized simulations further show that it is primarily the tropical part of the SST anomalies that influence the USGP. As such, the USGP tend to have above normal precipitation when the tropical Pacific SSTs are above normal, while there is a tendency for drought when the tropical SSTs are cold. The upper tropospheric response to the pan-Pacific SST EOF shows a global-scale pattern with a strong wave response in the Pacific and a substantial zonally-symmetric component in which USGP pluvial (drought) conditions are associated with reduced (enhanced) heights throughout the extra-tropics. The potential predictability of rainfall in the USGP associated with SSTs is rather modest, with on average about 1/3 of the total low frequency rainfall variance forced by SST anomalies. Further idealized experiments with climatological SST, suggest that the remaining low frequency variance in the USGP precipitation is the result of interactions with soil moisture. In particular, simulations with soil moisture feedback show a six-fold increase in the variance in annual USGP precipitation compared with simulations in which the soil feedback is excluded. In addition to increasing variance, the interactions with the soil introduce year-to-year memory in the hydrological cycle that is consistent with a red noise process, in which the low frequencies in the deep soil are the result of integrating a net forcing (precipitation-evaporation-runoff) that is white noise on interannual time scales. As such, the role of low frequency SST variability is to introduce a bias to the net forcing on the soil moisture that drives the random process preferentially to either wet or dry conditions.
Author
Atmospheric General Circulation Models; Computerized Simulation; Drought; Great Plains Corridor (North America); Sea Surface Temperature; Rain; Annual Variations; Climatology

20030031353 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model
Tao, Wei-Kuo; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The Goddard Cumulus Ensemble (GCE) model is used to examine the impact of various microphysical schemes, and vertical and horizontal resolution on the development, intensity and rainfall associated with mesoscale convective systems, idealized hurricanes and an ensemble of clouds. The model variables include horizontal and vertical velocities, potential temperature, perturbation pressure, turbulent kinetic energy, and mixing ratios of all water phases (vapor, liquid, and ice). The major characteristics of the GCE model are the explicit representation of warm rain and ice microphysical processes, and their complex interactions with solar and infrared radiative transfer processes. For idealized hurricane, an axisymmetric version of the GCE model was developed and used successfully to simulate the tropical cyclogenesis process using both a Rankin vortex and saturated air within a specified radius as initial conditions. For mesoscale convective systems, the 3-D version of the GCE model was used to simulate squall lines that developed in the western Pacific, South China Sea, eastern Atlantic, South America and central US. For the cloud ensemble, the GCE model was integrated for several days in order to have a good sampling of cloud statistics.
Author
Atmospheric Models; Clouds (Meteorology); Mesoscale Phenomena; Infrared Radiation; Radiative Transfer; Water Vapor; Cyclogenesis

20030031360 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999.
Jenkins, Gregory S.; Ryu, Jung-Hee; Thompson, Anne M.; Witte, Jacquelyn C.; February 10, 2002; 42 pp.; In English
Contract(s)/Grant(s): NAG5-7743; NSF ATM-01-05206; Copyright; Avail: CASI; A03, Hardcopy

The horizontal and vertical transport of biomass fire emissions in West Africa during November 1998 through February 1999, are examined using all available data including wind, fire, aerosol, precipitation, lightning and outgoing longwave radiation. Ozonesonde data from the Aerosols99 Trans-Atlantic cruise are also included with rain and wind analyses. The results here support earlier studies that ozone and ozone precursors associated with biomass burning are confined to the lower troposphere primarily due to the lack of deep convection over land areas. Ozone and its precursors are horizontally transported

equatorward or towards the west by winds in the 1000-700 hPa layers. However, rising adiabatic motions associated with the diurnal evolution of the West African n can transport ozone and its precursors vertically into the free troposphere above the marine boundary layer. Moreover, lightning from South America, Central Africa and mesoscale convective systems in the Gulf of Guinea can lead to elevated ozone mixing ratios in the middle and upper troposphere.
Author
Ozone; Tropical Regions; Winter; Northern Hemisphere; Vertical Air Currents; Africa; Biomass Burning; Horizontal Distribution; Planetary Boundary Layer; Adiabatic Conditions; Troposphere; Smoke

20030031371 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar
Reichardt, Jens; Baumgart, Rudolf; McGee, Thomsa J.; January 2003; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A method is presented that permits the determination of atmospheric depolarization-ratio profiles from three elastic-backscatter lidar signals with different sensitivity to the state of polarization of the backscattered light. The three-signal method is insensitive to experimental errors and does not require calibration of the measurement, which could cause large systematic uncertainties of the results, as is the case in the lidar technique conventionally used for the observation of depolarization ratios.
Author
Depolarization; Optical Radar; Calibrating; Polarized Light

20030031374 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000
Herman, J. R.; Ziemke, G.; Larko, D.; [2002]; 1 pp.; In English; SPIE Remote Sensing Symposium, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

The TOMS reflectivity time series 1980 to 1992 and 1997 to 2000 have been combined to estimate change that have occurred over a 21 year period. The relative calibration of the two TOMS (Nimbus-7, N7 and Earth-Probe, EP) has been adjusted using the measured minimum reflectivity over mid-latitude ocean and land locations (50 deg.). The result is that the N7 reflectivity has been decreased by 0.02 to match the better-calibrated Earth-Probe/TOMS. Most of the local trend features seen in the N7 time series (1980 to 1992) have been continued in the combined time series, but the overall zonal average and global trends have changed. The correlation of cloud cover with solar activity (measured by the 10.7 cm solar radiation) that was present during the Nimbus-7 period (1980 to 1992) is no longer evident for the period 1980 to 2000. The UV reflectivity data are compared with changes in the AVHRR outgoing long-wavelength radiation (OLR) and show an expected anti-correlation with cloud-cover changes over the same period for many, but not all, features. The key results include a continuing decrease in cloud cover over Europe and North America and an increase in reflectivity near Antarctica. This also means that the previously published N7 UV surface reflectivity climatology should be reduced by 0.02.
Author
Reflectance; Total Ozone Mapping Spectrometer; Advanced Very High Resolution Radiometer; Solar Radiation; Data Correlation; Intercalibration; Time Series Analysis

20030031379 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models
Cardinali, Carla; Rukhovets, Leonid; Tenenbaum, Joel; [2003]; 41 pp.; In English
Contract(s)/Grant(s): NAG5-2700; NAG5-9370; Copyright; Avail: CASI; A03, Hardcopy

We have utilized an extensive set of independent British Airways flight data recording wind vector and temperature observations (the Global Aircraft Data Set [GADS] archive) in three ways: (a) as an independent check of operational analyses; (b) as an analysis observing system experiment (OSE) as if the GADS observations were available in real time; and (c) as the corresponding forecast simulation experiment applicable to future operational forecasts. Using a 31 day sample (0000 UTC 20 December 2000 through 0000 UTC 20 January 2000) from Winter 2000, we conclude that over the data-dense continental U. S. analyzed jet streaks are too weak by -2\% to -5\%. Over nearby data-sparse regions of Canada, analyzed jet streaks are too weak by -5\% to -9\%. The second range provides a limit on the accuracy of current jet streak analyses over the portions of the -85\% of the earth's surface that are poorly covered by non-satellite observations. The -5\% to -9\% range is relevant for the pre-third generation satellite (AIRS, IASI, GIFTS) era.
Author
Jet Streams (Meteorology); Errors; Wind Velocity; Weather Forecasting; Real Time Operation

20030031380 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space

Heaps, William S.; Kawa, S. Randolph; [2002]; 1 pp.; In English; Remote Sensing of the Atmosphere, Ocean, Environment and Space, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

Global measurements of atmospheric carbon dioxides (CO2) are needed to resolve significant discrepancies that exist in our understanding of the global carbon budget and, therefore, man's role in global climate change. The science measurement requirements for CO2 are extremely demanding (precision c .3\%) No atmospheric chemical species has ever been measured from space with this precision. We are developing a novel application of a Fabry-Perot interferometer to detect spectral absorption of reflected sunlight by CO2 and O2 in the atmosphere. Preliminary design studies indicate that the method will be able to achieve the sensitivity and signal-to-noise required to measure column CO2 at the target specification. We are presently engaged in the construction of a prototype instrument for deployment on an aircraft to test the instrument performance and our ability to retrieve the data in the real atmosphere. In the first 6 months we have assembled a laboratory bench system to begin testing the optical and electronic components. We are also undertaking some measurements of signal and noise levels for actual sunlight reflecting from the ground. We shall present results from some of these ground based studies and discuss their implications for a space based system.

Author

Atmospheric Chemistry; Climatology; Carbon Dioxide Concentration; Measuring Instruments; Sensors

20030031382 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF

Hou, Arthur; Zhang, Sara; Reale, Oreste; [2002]; 1 pp.; In English; WCRP International Conference on Quantitative Precipitation Forecasting (QPF), 2-6 September 2002, Reading, UK; No Copyright; Avail: Other Sources; Abstract Only

Evaluation of QPF skills requires quantitatively accurate precipitation analyses. We show that assimilation of surface rain rates derived from the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager and Special Sensor Microwave/ Imager (SSM/I) improves quantitative precipitation estimates (QPE) and many aspects of global analyses. Short-range forecasts initialized with analyses with satellite rainfall data generally yield significantly higher QPF threat scores and better storm track predictions. These results were obtained using a variational procedure that minimizes the difference between the observed and model rain rates by correcting the moist physics tendency of the forecast model over a 6h assimilation window. In two case studies of Hurricanes Bonnie and Floyd, synoptic analysis shows that this procedure produces initial conditions with better-defined tropical storm features and stronger precipitation intensity associated with the storm.

Author

Precipitation (Meteorology); Rain; Remote Sensing; Trmm Satellite; Weather Forecasting; Microwave Sensors

20030031383 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model

Tao, Wei-Kuo; [2003]; 1 pp.; In English; IUGG/IAMAS Conference. JSM12: The Treatment of Precipitation in Cloud and Climate Model, 30 Jun. - 11 Jul. 2003, Sapporo, Japan; No Copyright; Avail: Other Sources; Abstract Only

The Goddard Cumulus Ensemble (GCE) model is used to examine the impact of various microphysical schemes, and vertical and horizontal resolution on the development, intensity and rainfall associated with mesoscale convective systems, idealized hurricanes and an ensemble of clouds. The model variables include horizontal and vertical velocities, potential temperature, perturbation pressure, turbulent kinetic energy, and mixing ratios of all water phases (vapor, liquid, and ice). The major characteristics of the GCE model are the explicit representation of warm rain and ice microphysical processes, and their complex interactions with solar and infrared radiative transfer processes, and with surface processes. For idealized hurricane, an axisymmetric version of the GCE model was developed and used successfully to simulate the tropical cyclogenesis process using both a Rankin vortex and saturated air within a specified radius as initial conditions. For mesoscale convective systems, the 3-D version of the GCE model was used to simulate squall lines that developed in the western Pacific, eastern Atlantic and central US. For the cloud ensemble, the GCE model was integrated for several days in order to have good sampling of cloud statistics. In this paper, the sensitivities of hurricane intensity to various microphysical processes and model grid resolution will be examined.

Author

Cumulus Clouds; Mesoscale Phenomena; Precipitation (Meteorology); Atmospheric Models; Free Convection; Radiative Transfer; Spatial Resolution

20030031384 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations

Tao, Wei-Kuo; Yoshizaki, Masanori; Shie, Chung-Lin; Kato, Teryuki; [2002]; 1 pp.; In English; International Conference on Mesoscale Convective Systems and Heavy Rainfall/Snowfall in East Asia, 29-31 Oct. 2002, Tokyo, Japan; Copyright; Avail: Other Sources; Abstract Only

Wintertime observations of MCSs (Mesoscale Convective Systems) over the Sea of Japan - 2001 (WMO-01) were collected from January 12 to February 1, 2001. One of the major objectives is to better understand and forecast snow systems and accompanying disturbances and the associated key physical processes involved in the formation and development of these disturbances. Multiple observation platforms (e.g., upper-air soundings, Doppler radar, wind profilers, radiometers, etc.) during WMO-01 provided a first attempt at investigating the detailed characteristics of convective storms and air pattern changes associated with winter storms over the Sea of Japan region. WMO-01 also provided estimates of the apparent heat source (Q1) and apparent moisture sink (Q2). The vertical integrals of Q1 and Q2 are equal to the surface precipitation rates. The horizontal and vertical adjective components of Q1 and Q2 can be used as large-scale forcing for the Cloud Resolving Models (CRMs). The Goddard Cumulus Ensemble (GCE) model is a CRM (typically run with a 1-km grid size). The GCE model has sophisticated microphysics and allows explicit interactions between clouds, radiation, and surface processes. It will be used to understand and quantify precipitation processes associated with wintertime convective systems over the Sea of Japan (using data collected during the WMO-01). This is the first cloud-resolving model used to simulate precipitation processes in this particular region. The GCE model-simulated WMO-01 results will also be compared to other GCE model-simulated weather systems that developed during other field campaigns (i.e., South China Sea, west Pacific warm pool region, eastern Atlantic region and central USA).

Author

Free Convection; Clouds (Meteorology); Atmospheric Models; Sea Of Japan; Mesoscale Phenomena; Snowstorms; Precipitation (Meteorology)

20030032179 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model

Tao, Wei-Kuo; Starr, David, Technical Monitor; [2002]; 1 pp.; In English; Japan Frontier Research System for Global Change, 28 Oct. 2002, Yokohama, Japan; No Copyright; Avail: Other Sources; Abstract Only

One of the most promising methods to test the representation of cloud processes used in climate models is to use observations together with Cloud Resolving Models (CRMs). The CRMs use more sophisticated and realistic representations of cloud microphysical processes, and they can reasonably well resolve the time evolution, structure, and life cycles of clouds and cloud systems (size about 2-200 km). The CRMs also allow explicit interaction between out-going longwave (cooling) and in-coming solar (heating) radiation with clouds. Observations can provide the initial conditions and validation for CRM results. The Goddard Cumulus Ensemble (GCE) Model, a CRM, has been developed and improved at NASA/Goddard Space Flight Center over the past two decades. The GCE model has been used to understand the following: 1) water and energy cycles and their roles in the tropical climate system; 2) the vertical redistribution of ozone and trace constituents by individual clouds and well organized convective systems over various spatial scales; 3) the relationship between the vertical distribution of latent heating (phase change of water) and the large-scale (pre-storm) environment; 4) the validity of assumptions used in the representation of cloud processes in climate and global circulation models; and 5) the representation of cloud microphysical processes and their interaction with radiative forcing over tropical and midlatitude regions. Four-dimensional cloud and latent heating fields simulated from the GCE model have been provided to the TRMM Science Data and Information System (TSDIS) to develop and improve algorithms for retrieving rainfall and latent heating rates for TRMM and the NASA Earth Observing System (EOS). More than 90 referred papers using the GCE model have been published in the last two decades. Also, more than 10 national and international universities are currently using the GCE model for research and teaching. In this talk, five specific major GCE improvements: (1) ice microphysics, (2) longwave and shortwave radiative transfer processes, (3) land surface processes, (4) ocean surface fluxes and (5) ocean mixed layer processes are presented. The performance of these new GCE improvements will be examined. Observations are used for model validation.

Author

Cumulus Clouds; Cloud Physics; Atmospheric Models; Climate Models

20030032181 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Rainfall Modification by Urban Areas: New Perspectives from TRMM

Shepherd, J. Marshall; Pierce, Harold F.; Negri, Andrew; [2002]; 1 pp.; In English; International TRMM Science Conference,, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

Data from the Tropical Rainfall Measuring Mission's (TRMM) Precipitation Radar (PR) were employed to identify warm season rainfall (1998-2000) patterns around Atlanta, Montgomery, Nashville, San Antonio, Waco, and Dallas. Results reveal an average increase of -28\% in monthly rainfall rates within 30-60 kilometers downwind of the metropolis with a modest increase of 5.6\% over the metropolis. Portions of the downwind area exhibit increases as high as 51\%. The percentage changes are relative to an upwind control area. It was also found that maximum rainfall rates in the downwind impact area exceeded the mean value in the upwind control area by 48\% - 116\%. The maximum value was generally found at an average distance of 39 km from the edge of the urban center or 64 km from the center of the city. Results are consistent with METROMEX studies of St. Louis almost two decades ago and with more recent studies near Atlanta. Future work is extending the investigation to Phoenix, Arizona, an arid U.S. city, and several international cities like Mexico City, Johannesburg, and Brasilia. The study establishes the possibility of utilizing satellite-based rainfall estimates for examining rainfall modification by urban areas on global scales and over longer time periods. Such research has implications for weather forecasting, urban planning, water resource management, and understanding human impact on the environment and climate.
Author
Rain; Resources Management; Water Resources; Wind Direction

20030032196 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems
Schoeberl, Mark R.; Douglass, Anne R.; Zhu, Zhengxin; Pawson, Steven; [2002]; 2 pp.; In English; AGU 2002 Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; Copyright; Avail: Other Sources; Abstract Only

We use kinematic and diabatic back trajectory calculations, driven by winds from a general circulation model (GCM) and two different data assimilation systems (DAS), to compute the age spectrum at three latitudes in the lower stratosphere. The age-spectra are compared to chemical transport model (CTM) calculations, and the mean ages from all of these studies are compared to observations. The age spectra computed using the GCM winds show a reasonably isolated tropics in good agreement with observations; however, the age spectra determined from the DAS differ from the GCM spectra. For the DAS diabatic trajectory calculations there is too much exchange between the tropics and mid-latitudes. The age spectrum is thus too broad and the tropical mean age is too old as a result of mixing older mid latitude air with tropical air. Likewise the mid latitude mean age is too young due to the in mixing of tropical air. The DAS kinematic trajectory calculations show excessive vertical dispersion of parcels in addition to excessive exchange between the tropics and mid latitudes. Because air is moved rapidly to the troposphere from the vertical dispersion, the age spectrum is shifted toward the young side. The excessive vertical and meridional dispersion compensate in the kinematic case giving a reasonable tropical mean age. The CTM calculation of the age spectrum using the DAS winds shows the same vertical and meridional dispersive characteristics of the kinematic trajectory calculation. These results suggest that the current DAS products will not give realistic trace gas distributions for long integrations; they also help explain why the extra tropical mean ages determined in a number of previous DAS driven CTM s are too young compared with observations. Finally, we note trajectory-generated age spectra . show significant age anomalies correlated with the seasonal cycles. These anomalies can be linked to year-to-year variations in the tropical heating rate. The anomalies are suppressed in the CTM spectra suggesting that the CTM transport scheme is too diffusive.
Author
Atmospheric General Circulation Models; Cycles; Computation; Latitude; Stratosphere; Spectra; Trace Contaminants

20030032234 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Visions of our Planet's Atmosphere, Land & Oceans
Hasler, Arthur F.; January 2002; 1 pp.; In English; The 107th STANYS Annual Convention, 3-5 Nov. 2002, Ellenville, NY, USA; No Copyright; Avail: Other Sources; Abstract Only

The NASA/NOAA Electronic Theater presents Earth science observations and visualizations in a historical perspective. Fly in from outer space to South Africa, Cape Town and Johannesburg using NASA Terra MODIS data, Landsat data and 1m IKONOS 'Spy Satellite' data. Zoom in to any place South Africa using Earth Viewer 3D from Keyhole Inc. and Landsat data at 30 m resolution. Go back to the early weather satellite images from the 1960s and see them contrasted with the latest US and international global satellite weather movies including hurricanes & 'tornadoes'. See the latest visualizations of spectacular images from NASA/NOAA remote sensing missions like Terra, GOES, TRMM, SeaWiFS, Landsat 7 including 1 - min GOES rapid scan image sequences of Nov 9th 2001 Midwest tornadic thunderstorms and have them explained. See how High-Definition Television (HDTV) is revolutionizing the way we present science to the public. See dust storms and flooding in Africa and smoke plumes from fires in Mexico. See visualizations featured on the covers of Newsweek, TIME,

National Geographic, Popular Science & on National & International Network TV. New computer software tools allow us to roam & zoom through massive global images e.g. Landsat tours of the US, and Africa, showing desert and mountain geology as well as seasonal changes in vegetation. See animations of the north and south polar ice packs and with icebergs on the coasts of Greenland and off the coast of Antarctica. Spectacular new visualizations of the global land, atmosphere & oceans are shown. Listen to the pulse of our planet. See how land vegetation, ocean plankton, clouds and temperatures respond to the sun & seasons. See vortexes and currents in the global oceans that bring up the nutrients to feed tiny algae and draw the fish, whales and fisherman. See the how the ocean blooms in response to these currents and El Nino/La Nina climate changes. See the city lights, fishing fleets, gas flares and biomass burning of the Earth at night observed by the 'night-vision' DMSP military satellite. The presentation will be made using the latest HDTV and video projection technology that is now done from a laptop computer through an entirely digital path.
Author
Earth Sciences; Noaa Satellites; Land Use; Oceans; Earth Atmosphere; Video Communication; NASA Programs; Climatology

20030032238 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Monitoring Global Precipitation Using Satellite Observations: Status and Future
Adler, Robert F.; Huffman, George; Curtis, Scott; Bolvin, David; Nelkin, Eric; January 2002; 2 pp.; In English; American Meteorological Society Annual Meeting, Long Beach, CA, USA; No Copyright; Avail: CASI; A01, Hardcopy

The current status of monitoring global precipitation amounts and patterns is described using data sets from the Global Precipitation Climatology Project (GPCP) of the World Climate Research Program (WCRP) and from recent research satellites, especially the Tropical Rainfall Measuring Mission (TRMM). The GPCP monthly (and pentad) data set is a 23-year, globally complete precipitation analysis that is used to explore global and regional variations and trends. The data set is a blend of data mainly from low-orbit microwave satellites and geosynchronous infrared satellites, with additional input from satellite sounder data, Outgoing Longwave Radiation (OLR) data and raingauges. The monthly GPCP data set shows no significant global trend in precipitation over the twenty years, unlike the positive trend in global surface temperatures over the past century. Regional trends are also analyzed. A trend pattern that is a combination of both El Nino and La Nina precipitation features is evident in the 23-year data set. This pattern is related to an increase with time in the number of combined months of El Nino and La Nina during the 23-year period. This apparent trend may be a short-term variation, but also might be related to the increase with time of extreme precipitation events reported elsewhere. Patterns of precipitation variation related to ENSO and other phenomena are shown with clear signals extending from the Tropics into middle and high latitudes of both hemispheres. Also shown, as an example of higher time resolution data is the GPCP daily analysis, which is available for the last six years. A second focus of the talk is on TRMM precipitation data and how these newer data sets incorporating information from the first space-borne meteorological radar compare with the established GPCP data sets.
Author
Climatology; Precipitation (Meteorology); Satellite Observation; Meteorological Radar; Meteorological Satellites

20030032242 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Singular Vectors for Moisture-Measuring Norms
Errico, Ronald M.; Raeder, Kevin; Ehrendorfer, Martin; [2002]; 44 pp.; In English
Contract(s)/Grant(s): NASA Order W-18077; N00173-96-MP-0086; FFWF Proj. P13729-GEO; Copyright; Avail: CASI; A03, Hardcopy

In dynamic meteorology, singular vectors (SVs) are the structures that maximize a given norm of a forecast perturbation given a tangent linear model and a quadratic constraint on the initial perturbation. That constraint is a prescription of the value of either the same or a different norm applied to the initial perturbations. In the sense that SVs maximize the forecast perturbations according to a specified measure, they may be considered as optimal perturbations. SVs are used to characterize predictability, to identify and correct possible initial errors given forecast errors, to create a set of significant perturbations for ensemble forecasting, or to determine locations for observation targeting. They are a specific application of generally defined singular vectors in mathematics.
Derived from text
Errors; Forecasting; Moisture; Perturbation; Predictions

20030032243 NASA Goddard Inst. for Space Studies, New York, NY, USA
Climate Controls on Carbon Sequestration in Eastern North America
Peteet, D. M.; Renik, B.; Maenza-Gmeich, T.; Kurdyla, D.; Guilderson, T.; [2002]; 2 pp.; In English; AGU Meeting, 5-8 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Mid-latitude forest ecosystems have been proposed as a 'missing sink' today. The role of soils (including wetlands) in this proposed sink is a very important unknown. In order to make estimates of future climate change effects on carbon storage, we can examine past wetland carbon sequestration. How did past climate change affect net wetland carbon storage? We present long-term data from existing wetland sites used for paleoclimate reconstruction to assess the net carbon storage in wetland over the last 15000 years. During times of colder and wetter climate, many mid-latitude sites show increases in carbon storage, while past warmer, drier climates produced decreases in storage. Comparison among bog, fen, swamp, and tidal marsh are demonstrated for the Hudson Valley region.
Author
Carbon; Climate Change; Ecosystems; Temperate Regions; Wetlands

20030032249 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere
Ahmad, Z.; Bhartia, P. K.; Krotkov, N.; [2003]; 48 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We use a Plane-Parallel Cloud (PPC) model to illustrate how Mie scattering from cloud particles interacts with Rayleigh scattering in the atmosphere and produces a complex wavelength dependence in the top-of-the-atmosphere (TOA) reflectances measured by satellite instruments that operate in the ultraviolet (UV) part of the spectrum. Comparisons of the PPC model-derived spectral dependence of reflectances with the Total Ozone Mapping Spectrometer (TOMS) measurements show surprisingly good agreement over a wide range of observational conditions. The PPC model results also are compared with the results of two other cloud models: Lambert Equivalent Reflectivity (LER) and Modified Lambert Equivalent Reflectivity (MLER) that have been used to analyze satellite data in the UV. These models assume that clouds are opaque Lambertian reflectors rather than Mie scattering particles. Although one of these models (MLER) agrees reasonably well with the data, the results from this model appear somewhat unphysical and may not be suitable for interpreting satellite data if one desires high accuracy. We also use the PPC model to illustrate how clouds can perturb tropospheric O3 absorption in complex ways that cannot be explained by models that treat them as reflecting surfaces rather than as volume scatterers.
Author
Clouds (Meteorology); Atmospheric Models; Ultraviolet Emission; Reflectance; Mie Scattering; Rayleigh Scattering; Backscattering

20030032252 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data
Thompson, Anne M.; [2003]; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The first climatological overview of total, stratospheric and tropospheric ozone in the southern hemisphere tropical and subtropics is based on ozone sounding data from 10 sites comprising the Southern Hemisphere Additional OZonesondes (SHADOZ) network. Observations were made over: Ascension Island; Nairobi, Kenya; Irene, South Africa; Reunion Island; Watukosek, Java; Fiji; Tahiti; American Samoa; San Cristobal, Galapagos; Natal, Brazil. The data reside at: http://code916.gsfc.nasa.gov/Data_services/shadoz. SHADOZ ozone time-series and profiles give a perspective on tropical total, stratospheric and tropospheric ozone. Prominent features are highly variable tropospheric ozone and a zonal wave-one pattern in total (and tropospheric) column ozone. Dynamical and chemical influences appear to be of comparable magnitude though model studies are needed to quantify this. In addition to leading the SHADOZ network, we have been producing near-real tropical tropospheric ozone ('TTO') data from the Total Ozone Mapping Spectrometer (TOMS) since 1997 with Prof. Hudson and students at the University of Maryland: http://metosrv2.umd.edu/~tropo. Further perspective on the complexity of tropospheric ozone variability is shown using satellite observations.
Author
Tropical Regions; Troposphere; Ozone; Atmospheric Composition; Remote Sensing; Atmospheric Sounding; Satellite Sounding

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*.

20030022698 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission
Esper, Jaime; Gervin, Jan; Kirchman, Frank; Middleton, Elizabeth; Knox, Robert; Gregg, Watson; Mannino, Antonio; McClain, Charles; Herman, Jay; Hall, Forrest; [2003]; 4 pp.; In English; 4th IAA Symposium on Small Satellites for Earth Observation, Apr. 2003, Berlin, Germany; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

As part of the Global Carbon Cycle research effort, an agency-wide planning initiative was organized between October 2000 and June 2001 by the NASA Goddard Space Flight Center (GSFC) at the behest of the Associate Administrator for Earth Science. The goal was to define future research and technology development activities needed for implementing a cohesive scientific observation plan. A timeline for development of missions necessary to acquire the selected new measurements was laid out, and included missions for low - medium density terrestrial biomass / coastal ocean / and ocean carbon. This paper will begin with the scientific justification and measurement requirements for these specific activities, explore the options for having separate or combined missions, and follow-up with an implementation study centered on a hyperspectral imager at geosynchronous altitudes.
Author
Carbon Cycle; Oceanography; Biomass; Earth Sciences; Imaging Techniques; Coasts

20030031356 NASA Goddard Space Flight Center, Greenbelt, MD, USA
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data
Luthcke, Scott B.; Zelensky, N. P.; Rowlands, D. D.; Lemoine, F. G.; Chinn, D. S.; Williams, T. A.; [2002]; 1 pp.; In English; American Geophysical Union Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Jason-1, launched on December 7,2001, is continuing the time series of centimeter level ocean topography observations as the follow-on to the highly successful TOPEX/POSEIDON (T/P) radar altimeter satellite. The precision orbit determination (POD) is a critical component to meeting the ocean topography goals of the mission. T P has demonstrated that the time variation of ocean topography can be determined with an accuracy of a few centimeters, thanks to the availability of highly accurate orbits based primarily on SLR+DORIS tracking. The Jason-1 mission is intended to continue measurement of the ocean surface with the same, if not better accuracy. Fortunately, Jason- 1 POD can rely on four independent tracking data types available including near continuous tracking data from the dual frequency codeless BlackJack GPS receiver. Orbit solutions computed using individual and various combinations of GPS, SLR, DORIS and altimeter crossover data types have been determined from over 100 days of Jason-1 tracking data, The performance of the orbit solutions and tracking data has been evaluated. Orbit solution evaluation and comparison has provided insight into possible areas of refinement. Several aspects of the POD process are examined to obtain orbit improvements including measurement modeling, force modeling and solution strategy. The results of these analyses will be presented.
Author
Topography; Time Series Analysis; Poseidon Satellite; Orbit Determination; Ocean Surface

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*.

20030022747 NASA Ames Research Center, Moffett Field, CA, USA
Redundancies in Large-scale Protein Interaction Networks
Samanta, Manoj Pratim; Liang, Shoudan; January 21, 2003; 10 pp.; In English
Contract(s)/Grant(s): NAS2-19303; RTOP 519-90-12; Copyright; Avail: Other Sources

Understanding functional associations among genes discovered in sequencing projects is a key issue in post-genomic biology. However, reliable interpretation of the protein interaction data has been difficult. In this work, we show that if two proteins share significantly larger number of common interaction partners than random, they have close functional associations. Analysis of publicly available data from Saccharomyces cerevisiae reveals more than 2800 reliable functional associations, 29\% of which involve at least one unannotated protein. By further analyzing these associations, we derive tentative functions for 81 unannotated proteins with high certainty.
Author
Genome; Proteins; Saccharomyces

20030022758 NASA Ames Research Center, Moffett Field, CA, USA
Neural Dynamics Underlying Event-Related Potentials
Shah, Ankoor S.; Bressler, Steven L.; Knuth, Kevin H.; Ding, Ming-Zhou; Mehta, Ashesh D.; Ulbert, Istvan; Schroeder, Charles E.; [2003]; 25 pp.; In English
Contract(s)/Grant(s): MH060358; T32M07288; IBN0090717; MH64204; Copyright; Avail: CASI; A03, Hardcopy

There are two opposing hypotheses about the brain mechanisms underlying sensory event-related potentials (ERPs). One holds that sensory ERPs are generated by phase resetting of ongoing electroencephalographic (EEG) activity, and the other that they result from signal averaging of stimulus-evoked neural responses. We tested several contrasting predictions of these hypotheses by direct intracortical analysis of neural activity in monkeys. Our findings clearly demonstrate evoked response contributions to the sensory ERP in the monkey, and they suggest the likelihood that a mixed (Evoked/Phase Resetting) model may account for the generation of scalp ERPs in humans.
Author
Brain; Monkeys; Neurons; Sensory Perception

53
BEHAVIORAL SCIENCES

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

20030032250 Defence Science and Technology Organisation, Edinburgh, Australia
Implicit Communication in Novice and Expert Teams
Swain, Kelly; Mills, Vanessa, Defenc; January 2003; 31 pp.; In English
Report No.(s): DSTO-TN-0474; DODA-AR-012-550; Copyright; Avail: Other Sources

The current study aimed to pilot a methodology for measuring implicit communication processes in novice and expert teams. To achieve this, implicit communication in expert teams (civilian and military) was compared with novice teams performing the same task. Analysis showed that expert teams, or those that have worked together previously, use more implicit communication strategies to achieve team goals than novice teams, regardless of their area of expertise (military, sporting or business teams). This suggests that expert teams may be utilising shared mental models of both the roles of their teammates and how they should be working together in a group situation. The researchers conclude that the training of military teams in the roles and responsibilities of their teammates is an important issue for the Australian Defence Force. This is particularly the case where teams are physically distributed across the battlespace.
Author
Verbal Communication; Teams; Group Dynamics; Training Analysis; Human Behavior; Communicating

20030032251 Defence Science and Technology Organisation, Edinburgh, Australia
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination
Chapman, Taryn; Mills, Vanessa; Kardos, Monique; Stothard, Christina; Williams, Douglas; December 2002; 71 pp.; In English; Original contains color illustrations
Report No.(s): DSTO-TR-1372; DODA-AR-012-518; Copyright; Avail: Other Sources

The Janus wargame was assessed as a means of investigating naturalistic decision-making (NDM). A further aim was to establish the generality of previous research that uses non-military simulation. Participants were divided into hierarchically structured teams of 3 (one military team, and three civilian teams). Each team was tested using open and restricted communication architectures. In line with predictions, open communication was more effective than restricted communication. In addition, military personnel out-performed civilian participants. No linear or quadratic patterns were found regarding the development of expertise. It was concluded that Janus was an effective means of examining NDM. In addition, the data

indicated that non-military simulation can generate valid data in relation to communication architectures, but not in relation to the development of military expertise.
Author
Decision Making; War Games; Teams; Computerized Simulation; Communication; Training Analysis

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

20030022706 NASA Ames Research Center, Moffett Field, CA, USA
Agent Interaction with Human Systems in Complex Environments: Requirements for Automating the Function of CapCom in Apollo 17
Clancey, William J.; February 2003; 8 pp.; In English; AIAA Spring Workshop, Mar. 2003; No Copyright; Avail: CASI; A02, Hardcopy

A human-centered approach to computer systems design involves reframing analysis in terms of people interacting with each other, not only human-machine interaction. The primary concern is not how people can interact with computers, but how shall we design computers to help people work together? An analysis of astronaut interactions with CapCom on Earth during one traverse of Apollo 17 shows what kind of information was conveyed and what might be automated today. A variety of agent and robotic technologies are proposed that deal with recurrent problems in communication and coordination during the analyzed traverse.
Author
Computer Systems Design; Man Machine Systems; Astronauts

20030025359 Defence Science and Technology Organisation, Edinburgh, Australia
The Effects of Information Technology on Intra-Human Communication in the Workplace
Mills, Vanessa; December 2002; 30 pp.; In English
Report No.(s): DSTO-GD-0347; DODA-AR-012-515; Copyright; Avail: Other Sources

The aim of this report is to summarize key aspects of human interaction that may be affected by the introduction of the Battlefield Command Support System (BCSS) to the Australian Army. Specific areas of analysis include the social nature of knowledge, implicit communication processes, and team processes. There is also discussion of common misperceptions regarding the promise of computers, and successful and unsuccessful methods of introducing new technology in relation to human interaction. It is concluded that successful design and integration of BCSS requires a deep understanding of the implicit aspects of human behaviour, and the contribution of the social fabric. A series of suggestions on how this could be achieved is provided.
Author
Human Factors Engineering; Command And Control; Systems Engineering; Military Technology; Workloads (Psychophysiology); Communication; Information Systems

55
EXOBIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

20030023599 NASA Ames Research Center, Moffett Field, CA, USA
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature
DesMarais, David J.; Bebout, Brad M.; Carpenter, Steven; Discipulo, Mykell; Turk, Kendra; January 22, 2003; 2 pp.; In English; National Astrobiology Inst. Meeting, 10-11 Feb. 2003, Tempe, AZ, USA
Contract(s)/Grant(s): RTOP 344-50-92-02; Copyright; Avail: CASI; A01, Hardcopy

The hierarchical organization of microbial ecosystems determines the rates of processes that shape Earth#s environment, define the stage upon which major evolutionary events occurred, and create biosignatures in sediments and atmospheres. In

cyanobacterial mats, oxygenic photosynthesis provides energy, organic substrates and oxygen to the ecosystem. Incident light changes with depth in the mat, both in intensity and spectral composition, and counteracting gradients of oxygen and sulfide shape the chemical microenvironment. A combination of benefits and hazards of light, oxygen and sulfide promotes the allocation of the various essential mat processes between light and dark periods and to various depths in the mat. Microbiota produce hydrogen, small organic acids, and nitrogen and sulfur species. Such compounds fuel a flow of energy and electrons in these ecosystems and thus shape interactions between groups of microorganisms. Coordinated observations of population distribution, abundance, and activity for an entire community are making fundamental questions in ecology accessible. These questions address those factors that sustain the remarkable diversity of microorganisms that are now being revealed by molecular techniques. These questions also target the processes that shape the various kinds of biosignatures that we will seek, both in ancient rocks from Earth and Mars, and in atmospheres of distant planets beyond our Solar System.
Author
Temperature Effects; Carbon; Oxygen; Microorganisms; Ecosystems; Sulfur

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

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

20030022717 Texas Univ., San Antonio, TX, USA
Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century
Robbins, Kay A.; [2003]; 5 pp.; In English
Contract(s)/Grant(s): NAG2-6040; No Copyright; Avail: CASI; A01, Hardcopy

The dramatic technological developments of the past decade have led to a tremendous growth in the demand for computer science professionals well-versed in advanced technology and techniques. NASA, traditionally a haven for cutting-edge innovators, is now competing with every industrial and government sector for computer science talent. The computer science program at University of Texas at San Antonio (UTSA) faces challenges beyond those intrinsically presented by rapid technological change, because a significant number of UTSA students come from low-income families with no Internet or computer access at home. An examination of enrollment statistics for the computer science program at UTSA showed that very few students who entered as freshmen successfully graduated. The upper division courses appeared to be populated by graduate students removing deficiencies and by transfer students. The faculty was also concerned that the students who did graduate from the program did not have the strong technical and programming skills that the CS program had been noted for in the community during the 1980's.
Derived from text
NASA Programs; Computer Programming; Education; Technology Transfer

20030032208 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Primer Vector Optimization: Survey of Theory, New Analysis and Applications
Guzman, J. J.; Mailhe, L. M.; Schiff, C.; Hughes, S. P.; Folta, D. C.; [2002]; 12 pp.; In English; 53rd International Astronautical Congress: The World Space Congress - 2002, 10-19 Oct. 2002, Houston, TX, USA
Contract(s)/Grant(s): NAS5-01090
Report No.(s): IAC-02-A. 6.09; Copyright; Avail: CASI; A03, Hardcopy

In this paper, a summary of primer vector theory is presented. The applicability of primer vector theory is examined in an effort to understand when and why the theory can fail. For example, since the Calculus of Variations is based on 'small' variations, singularities in the linearized (variational) equations of motion along the arcs must be taken into account. These singularities are a recurring problem in analyse that employ small variations. Two examples, the initialization of an orbit and a line of apsides rotation, are presented. Recommendations, future work, and the possible addition of other optimization techniques are also discussed.
Author
Singularity (Mathematics); Vectors (Mathematics); Linearization; Calculus Of Variations; Optimization

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*.

20030020950 NASA Ames Research Center, Moffett Field, CA, USA
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations
Kikuchi, Hideaki; Kalia, Rajiv K.; Nakano, Aiichiro; Vashishta, Priya; Shimojo, Fuyuki; Saini, Subhash; [2003]; 8 pp.; In English; International Parallel and Distributed Computing Conference, 22-26 Apr. 2003, Nice, France; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

Scalability of a low-cost, Intel Xeon-based, multi-Teraflop Linux cluster is tested for two high-end scientific applications: Classical atomistic simulation based on the molecular dynamics method and quantum mechanical calculation based on the density functional theory. These scalable parallel applications use space-time multiresolution algorithms and feature computational-space decomposition, wavelet-based adaptive load balancing, and spacefilling-curve-based data compression for scalable I/O. Comparative performance tests are performed on a 1,024-processor Linux cluster and a conventional higher-end parallel supercomputer, 1,184-processor IBM SP4. The results show that the performance of the Linux cluster is comparable to that of the SP4. We also study various effects, such as the sharing of memory and L2 cache among processors, on the performance.
Author
Computer Systems Performance; Computerized Simulation; Computer Systems Design; Performance Tests; Architecture (Computers); Parallel Processing (Computers); Distributed Memory

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.

20030020873 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Spacecraft Angular State Estimation After Sensor Failure
Bauer, Frank, Technical Monitor; BarItzhack, Itzhack Y.; Harman, Richard R.; October 2002; 6 pp.; In English; Intelligent Systems and Control (ISC 2002), 2-4 Oct. 2002, Tsukuba, Japan; No Copyright; Avail: CASI; A02, Hardcopy

This work describes two algorithms for computing the angular rate and attitude in case of a gyro failure in a spacecraft (SC) with a special mission profile. The source of the problem is presented, two algorithms are suggested, an observability study is carried out, and the efficiency of the algorithms is demonstrated.
Author
Algorithms; Angular Velocity; State Estimation; Spacecraft Instruments

20030022673 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
HEASARC Software Archive
White, Nicholas, Technical Monitor; Murray, Stephen S.; April 2003; 3 pp.; In English
Contract(s)/Grant(s): NCC5-568; No Copyright; Avail: CASI; A01, Hardcopy

(1) Chandra Archive: SAO has maintained the interfaces through which HEASARC gains access to the Chandra Data Archive. At HEASARC's request, we have implemented an anonymous ftp copy of a major part of the public archive and we keep that archive up-to- date. SAO has participated in the ADEC interoperability working group, establishing guidelines or interoperability standards and prototyping such interfaces. We have provided an NVO-based prototype interface, intending to serve the HEASARC-led NVO demo project. HEASARC's Astrobrowse interface was maintained and updated. In addition, we have participated in design discussions surrounding HEASARC's Caldb project. We have attended the HEASARC Users Group meeting and presented CDA status and developments. (2) Chandra CALDB: SA0 has maintained and expanded the Chandra CALDB by including four new data file types, defining the corresponding CALDB keyword/identification structures. We have provided CALDB upgrades for the public (CIAO) and for Standard Data Processing. Approximately 40 new files have been added to the CALDB in these version releases. There have been in the past year ten of these CALDB upgrades, each with unique index configurations. In addition, with the inputs from software, archive, and calibration scientists, as well

as CIAO/SDP software developers, we have defined a generalized expansion of the existing CALDB interface and indexing structure. The purpose of this is to make the CALDB more generally applicable and useful in new and future missions that will be supported archivally by HEASARC. The generalized interface will identify additional configurational keywords and permit more extensive calibration parameter and boundary condition specifications for unique file selection. HEASARC scientists and developers from SAO and GSFC have become involved in this work, which is expected to produce a new interface for general use within the current year. (3) DS9: One of the decisions that came from last year's HEADCC meeting was to make the ds9 image display program the primary vehicle for displaying line graphics (as well as images). The first step required to make this possible was to enhance the line graphics capabilities of ds9. SAO therefore spent considerable effort upgrading ds9 to use Tcl 8.4 so that the BLT line graphics package could be built and imported into ds9 from source code, rather than from a pre-built (and generally outdated) shared library. This task, which is nearly complete, allows us to extend BLT as needed for the HEAD community. Following HEADCC discussion concerning archiving and the display of archived data, we extended ds9 to support full access to many astronomical Web-based archives sites, including HEASARC, MAST, CHANDRA, SKYVIEW, ADS, NED, SIMBAD, IRAS, NVRO, SAO TDC, and FIRST. Using ds9's new internal Web access capabilities, these archives can be accessed via their Web page. FITS images, plots, spectra, and journal abstracts can be referenced, down-loaded, and displayed directly and easily in ds9. For more information, see: http://hea-www.harvard.edu/saord/ds9. Also after the HEADCC discussion concerning region filtering, we extended the Funtools sample implementation of region filtering as described in: http://hea-www.harvard.edu/saord/funtools/regions.html. In particular, we added several new composite regions for event and image filtering, including elliptical and box annuli. We also extended the panda (Pie AND Annulus) region support to include box pandas and elliptical pandas. These new composite regions are especially useful in programs that need to count photons in each separate region using only a single pass through the data. Support for these new regions was added to ds9. In the same vein, we developed new region support for filtering images using simple FITS image masks, i.e. 8-bit or 16-bit FITS images where the value of a pixel is the region id number for that pixel. Other important enhancements to DS9 this year, include supporor multiple world coordinate systems, three dimensional event file binning, image smoothing, region groups and tags, the ability to save images in a number of image formats (such as JPEG, TIFF, PNG, FITS), improvements in support for integrating external analysis tools, and support for the virtual observatory. In particular, a full-featured web browser has been implemented within D S 9 . This provides support for full access to HEASARC archive sites such as SKYVIEW and W3BROWSE, in addition to other astronomical archives sites such as MAST, CHANDRA, ADS, NED, SIMBAD, IRAS, NVRO, SA0 TDC, and FIRST. From within DS9, the archives can be searched, and FITS images, plots, spectra, and journal abstracts can be referenced, downloaded and displayed The web browser provides the basis for the built-in help facility. All DS9 documentation, including the reference manual, FAQ, Know Features, and contact information is now available to the user without the need for external display applications. New versions of DS9 maybe downloaded and installed using this facility. Two important features used in the analysis of high energy astronomical data have been implemented in the past year. The first is support for binning photon event data in three dimensions. By binning the third dimension in time or energy, users are easily able to detect variable x-ray sources and identify other physical properties of their data. Second, a number of fast smoothing algorithms have been implemented in DS9, which allow users to smooth their data in real time. Algorithms for boxcar, tophat, and gaussian smoothing are supported.
Author

Data Processing; Documents; Computer Programs; Memory (Computers); Boundary Conditions; Interoperability

20030022684 NASA Ames Research Center, Moffett Field, CA, USA

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers

Tumer, K.; Lawson, J., Kluwer; January 2003; 20 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Efficient management of large-scale, distributed data storage and processing systems is a major challenge for many computational applications. Many of these systems are characterized by multi-resource tasks processed across a heterogeneous network. Conventional approaches, such as load balancing, work well for centralized, single resource problems, but breakdown in the more general case. In addition, most approaches are often based on heuristics which do not directly attempt to optimize the world utility. In this paper, we propose an agent based control system using the theory of collectives. We configure the servers of our network with agents who make local job scheduling decisions. These decisions are based on local goals which are constructed to be aligned with the objective of optimizing the overall efficiency of the system. We demonstrate that multi-agent systems in which all the agents attempt to optimize the same global utility function (team game) only marginally outperform conventional load balancing. On the other hand, agents configured using collectives outperform both

team games and load balancing (by up to four times for the latter), despite their distributed nature and their limited access to information.
Author
Programming (Scheduling); Computational Grids; Distributed Processing; Optimization; Computer Networks; Data Storage; Architecture (Computers)

20030022709 Kansas State Univ., Manhattan, KS, USA
Foundations of the Bandera Abstraction Tools
Hatcliff, John; Dwyer, Matthew B.; Pasareanu, Corina S.; Robby; [2003]; 32 pp.; In English
Contract(s)/Grant(s): NAS2-00065; DAAD19-01-110564; F33615-00-C-3044; NSF CCR-97-03094; NSF CCR-97-08184; NSF CCR-98-96354; NSF CCR 99-01605; NCC1-399; NAG2-1209; No Copyright; Avail: CASI; A03, Hardcopy

Current research is demonstrating that model-checking and other forms of automated finite-state verification can be effective for checking properties of software systems. Due to the exponential costs associated with model-checking, multiple forms of abstraction are often necessary to obtain system models that are tractable for automated checking. The Bandera Tool Set provides multiple forms of automated support for compiling concurrent Java software systems to models that can be supplied to several different model-checking tools. In this paper, we describe the foundations of Bandera's data abstraction mechanism which is used to reduce the cardinality (and the program's state-space) of data domains in software to be model-checked. From a technical standpoint, the form of data abstraction used in Bandera is simple, and it is based on classical presentations of abstract interpretation. We describe the mechanisms that Bandera provides for declaring abstractions, for attaching abstractions to programs, and for generating abstracted programs and properties. The contributions of this work are the design and implementation of various forms of tool support required for effective application of data abstraction to software components written in a programming language like Java which has a rich set of linguistic features.
Author
Computer Programs; Software Engineering; Program Verification (Computers); Domains

20030022734 NASA Ames Research Center, Moffett Field, CA, USA
Chapman-1024 Processor Shared Memory
Ciotii, Robert; February 03, 2003; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

NASA has developed new technology that improves upon weakness in current mainstream supercomputer designs: those of 'scalability,' 'humadmachine interface,' and 'load balancing.' The system simplifies running large computer simulations of national and international importance like climate prediction and space vehicle design.
Author
Technology Assessment; Climate; Computerized Simulation

20030022751 Research Inst. for Advanced Computer Science, Moffett Field, CA, USA Kestrel Technology, LLC, Moffett Field, CA, USA
The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification
Havelund, Klaus; Filman, Robert; Korsmeyer, David, Technical Monitor; January 31, 2003; 6 pp.; In English; Workshop on Software-engineering Properties of Languages for Aspect Technologies
Contract(s)/Grant(s): NCC2-1006; No Copyright; Avail: CASI; A02, Hardcopy

We consider the impact of Aspect-Oriented Programming on Software Engineering, and, in particular, analyze two AOP systems, one of which does component wrapping and the other, quantification over events, for their software engineering effects.
Author
Computer Programming; Software Engineering; Systems Analysis

20030025284 NASA Ames Research Center, Moffett Field, CA, USA
Human Centered Design and Development for NASA's MerBoard
Trimble, Jay; January 10, 2003; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides an overview of the design and development process for NASA's MerBoard. These devices are large interactive display screens which can be shown on the user's computer, which will allow scientists in many locations to interpret and evaluate mission data in real-time. These tools are scheduled to be used during the 2003 Mars

Exploration Rover (MER) expeditions. Topics covered include: mission overview, Mer Human Centered Computers, FIDO 2001 observations and MerBoard prototypes.
Author
Display Devices; Human-Computer Interface; Applications Programs (Computers); Systems Engineering; Information Transfer; Information Dissemination

20030025348 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming
Dorband, John E.; Aburdene, Maurice F.; January 2002; 6 pp.; In English; Frontiers in Education 2002, 6-9 Nov. 2002, Boston, MA, USA; Copyright; Avail: CASI; A02, Hardcopy

Recently, networked and cluster computation have become very popular. This paper is an introduction to a new C based parallel language for architecture-adaptive programming, aCe C. The primary purpose of aCe (Architecture-adaptive Computing Environment) is to encourage programmers to implement applications on parallel architectures by providing them the assurance that future architectures will be able to run their applications with a minimum of modification. A secondary purpose is to encourage computer architects to develop new types of architectures by providing an easily implemented software development environment and a library of test applications. This new language should be an ideal tool to teach parallel programming. In this paper, we will focus on some fundamental features of aCe C.
Author
Architecture (Computers); C (Programming Language); Parallel Programming

20030025676 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Recursive Hierarchical Image Segmentation by Region Growing and Constrained Spectral Clustering
Tilton, James C.; December 2002; 1 pp.; In English; European Union Satellite Centre (EUSC), 4-7 Dec. 2002, Rome, Italy; No Copyright; Avail: Other Sources; Abstract Only

This paper describes an algorithm for hierarchical image segmentation (referred to as HSEG) and its recursive formulation (referred to as RHSEG). The HSEG algorithm is a hybrid of region growing and constrained spectral clustering that produces a hierarchical set of image segmentations based on detected convergence points. In the main, HSEG employs the hierarchical stepwise optimization (HS WO) approach to region growing, which seeks to produce segmentations that are more optimized than those produced by more classic approaches to region growing. In addition, HSEG optionally interjects between HSWO region growing iterations merges between spatially non-adjacent regions (i.e., spectrally based merging or clustering) constrained by a threshold derived from the previous HSWO region growing iteration. While the addition of constrained spectral clustering improves the segmentation results, especially for larger images, it also significantly increases HSEG's computational requirements. To counteract this, a computationally efficient recursive, divide-and-conquer, implementation of HSEG (RHSEG) has been devised and is described herein. Included in this description is special code that is required to avoid processing artifacts caused by RHSEG s recursive subdivision of the image data. Implementations for single processor and for multiple processor computer systems are described. Results with Landsat TM data are included comparing HSEG with classic region growing. Finally, an application to image information mining and knowledge discovery is discussed.
Author
Applications Programs (Computers); Imaging Techniques; Algorithms

20030028932 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Goddard VLBI SINEX Files
Ma, Chopo; Petrov, Leonid; [2002]; 1 pp.; In English; IERS Workshop on Combination Research and Global Geophysical Fluids, 18-21 Nov. 2002, Munich, Germany; No Copyright; Avail: Other Sources; Abstract Only

The Goddard VLBI group generates SINEX files for individual 24-hr sessions and multiyear TRF solutions. Each 24-hr file includes the reduced normal matrix for the station positions, EOP, and EOP rates. A global Terrestrial Reference Frame (TRF) SINEX file has the reduced normal matrix for station positions and velocities but no EOP parameters. Both types of normal matrix are free from any datum constraints and are designed for combination solutions that will later apply the necessary datum constraints. The SINEX files also contain blocks that provide the constraints and covariance of well-defined 24-hr or global TRF solutions. These blocks are not yet part of the SINEX 2.0 specification. For the TRF solutions the Goddard VLBI group also generates the corresponding EOP time series. SINEX files and EOP time series are distributed through the

IVS. The algorithms for generating the various blocks and the proper use of such SINEX files will be discussed.
Author
Very Long Base Interferometry; Time Series Analysis; File Maintenance (Computers)

20030032200 Defence Science and Technology Organisation, Edinburgh, Australia
Validation of Agent Based Distillation Movement Algorithms
Gill, Andrew W.; Grieger, Dion, Defenc; January 2003; 40 pp.; In English; Original contains color illustrations
Report No.(s): DSTO-TN-0476; DODA-AR-012-55; Copyright; Avail: Other Sources

Agent based distillations (ABD) are low-resolution abstract models, which can be used to explore questions associated with land combat operations in a short period of time. Movement of agents within the EINSTein and MANA ABDs is based on a simple attraction-repulsion weighting system and an associated numerical penalty function. The relative simplicity of these ABDs seems to have led to the general acceptance of their associated movement algorithms, without much validation or analysis of behaviour. This paper analyses these movement algorithms and finds unwanted behaviour, and proposes suggestions for improvement to the penalty function based on relative distances. A novel technique based on the concepts underlying spatial estimation is also proposed as an alternative.
Author
Combat; Models; Algorithms

20030032237 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Integrated Analysis-Test Approach
Kaufman, Daniel; [2003]; 11 pp.; In English; European Conference on Spacecraft Structures, 11-13 Dec. 2003, Toulouse, France; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides an overview of a project to develop a computer program which integrates data analysis and test procedures. The software application aims to propose a new perspective to traditional mechanical analysis and test procedures and to integrate pre-test and test analysis calculation methods. The program also should also be able to be used in portable devices and allows for the 'quasi-real time' analysis of data sent by electronic means. Test methods reviewed during this presentation include: shaker swept sine and random tests, shaker shock mode tests, shaker base driven model survey tests and acoustic tests.
CASI
Computer Programs; Tests; Data Processing

20030032256 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Using Pilots to Assess the Value and Approach of CMMI Implementation
Godfrey, Sara; Andary, James; Rosenberg, Linda; [2002]; 11 pp.; In English; 2nd Annual CMMI Technology Conference and User's Group, 11-14 Nov. 2002, Denver, CO, USA; Original document has black marks on right side.; No Copyright; Avail: CASI; A03, Hardcopy

At Goddard Space Flight Center (GSFC), we have chosen to use Capability Maturity Model Integrated (CMMI) to guide our process improvement program. Projects at GSFC consist of complex systems of software and hardware that control satellites, operate ground systems, run instruments, manage databases and data and support scientific research. It is a challenge to launch a process improvement program that encompasses our diverse systems, yet is manageable in terms of cost effectiveness. In order to establish the best approach for improvement, our process improvement effort was divided into three phases: 1) Pilot projects; 2) Staged implementation; and 3) Sustainment and continual improvement. During Phase 1 the focus of the activities was on a baselining process, using pre-appraisals in order to get a baseline for making a better cost and effort estimate for the improvement effort. Pilot pre-appraisals were conducted from different perspectives so different approaches for process implementation could be evaluated. Phase 1 also concentrated on establishing an improvement infrastructure and training of the improvement teams. At the time of this paper, three pilot appraisals have been completed. Our initial appraisal was performed in a flight software area, considering the flight software organization as the organization. The second appraisal was done from a project perspective, focusing on systems engineering and acquisition, and using the organization as GSFC. The final appraisal was in a ground support software area, again using GSFC as the organization. This paper will present our initial approach, lessons learned from all three pilots and the changes in our approach based on the lessons learned.
Author
Project Management; Applications Programs (Computers); Complex Systems; Software Engineering; Management Systems

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.

20030022715 NASA Ames Research Center, Moffett Field, CA, USA
Arithmetic Data Cube as a Data Intensive Benchmark
Frumkin, Michael A.; Shabano, Leonid; January 23, 2003; 7 pp.; In English
Contract(s)/Grant(s): RTOP 704-42-42; Copyright; Avail: CASI; A02, Hardcopy

Data movement across computational grids and across memory hierarchy of individual grid machines is known to be a limiting factor for application involving large data sets. In this paper we introduce the Data Cube Operator on an Arithmetic Data Set which we call Arithmetic Data Cube (ADC). We propose to use the ADC to benchmark grid capabilities to handle large distributed data sets. The ADC stresses all levels of grid memory by producing 2d views of an Arithmetic Data Set of d-tuples described by a small number of parameters. We control data intensity of the ADC by controlling the sizes of the views through choice of the tuple parameters.
Author
Arithmetic; Computer Systems Performance; Data Transfer (Computers)

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*.

20030022793 NASA Ames Research Center, Moffett Field, CA, USA
Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry
Knuth, Kevin H.; [2003]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The last century saw the application of Boolean algebra toward the construction of computing machines, which work by applying logical transformations to information contained in their memory. The development of information theory and the generalization of Boolean algebra to Bayesian inference have enabled these computing machines. in the last quarter of the twentieth century, to be endowed with the ability to learn by making inferences from data. This revolution is just beginning as new computational techniques continue to make difficult problems more accessible. However, modern intelligent machines work by inferring knowledge using only their pre-programmed prior knowledge and the data provided. They lack the ability to ask questions, or request data that would aid their inferences. Recent advances in understanding the foundations of probability theory have revealed implications for areas other than logic. Of relevance to intelligent machines, we identified the algebra of questions as the free distributive algebra, which now allows us to work with questions in a way analogous to that which Boolean algebra enables us to work with logical statements. In this paper we describe this logic of inference and inquiry using the mathematics of partially ordered sets and the scaffolding of lattice theory, discuss the far-reaching implications of the methodology, and demonstrate its application with current examples in machine learning. Automation of both inference and inquiry promises to allow robots to perform science in the far reaches of our solar system and in other star systems by enabling them to not only make inferences from data, but also decide which question to ask, experiment to perform, or measurement to take given what they have learned and what they are designed to understand.
Author
Inference; Information Theory; Artificial Intelligence; Machine Learning

20030025360 NASA Ames Research Center, Moffett Field, CA, USA
The Intelligent Data Understanding Element of NASA's Intelligent Systems Program
Coughlan, Joseph C.; Tilton, James C.; Rood, Richard, Technical Monitor; [2002]; 1 pp.; In English; European Union Satellite Centre (EUSC), 4-7 Dec. 2002, Rome, Italy; No Copyright; Avail: Other Sources; Abstract Only

Within the NASA Intelligent Systems Program, the Intelligent Data Understanding (IDU) element develops techniques for transforming data into scientific understanding. Automating such tools is critical for space science, space-based earth science, and planetary exploration with onboard scientific data analysis. Intelligent data understanding (IDU) is about extracting meaning from large, diverse science and engineering databases, via autonomous techniques that transform very large datasets into understanding. The earth science community in particular needs new tools for analyzing multi-formatted

and geographically distributed datasets and for identifying cause-effect relationships in the complex data. Research within the IDU program element seeks to automate data analysis tasks so that humans can focus on creative hypothesis generation and knowledge synthesis. It may also enable NASA space missions in which autonomous agents must generate knowledge and take actions, and missions where limited bandwidth permits transmission of only the most interesting scientific observations, summaries, and conclusions. Twenty-seven research projects are-currently funded.
Author
NASA Space Programs; Artificial Intelligence; Autonomy; Data Bases

64
NUMERICAL ANALYSIS

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

20030025779 NASA Langley Research Center, Hampton, VA, USA
Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations
Kennedy, Christopher A.; Carpenter, Mark H., Elsevi; Applied Numerical Mathematics; January 2002; ISSN 0168-9274; Volume 44, pp. 139-181; In English; Copyright; Avail: Other Sources

Additive Runge-Kutta (ARK) methods are investigated for application to the spatially discretized one- dimensional convection-diffusion-reaction (CDR) equations. Accuracy, stability, conservation, and dense-output are first considered for the general case when N different Runge-Kutta methods are grouped into a single composite method. Then, implicit-explicit, (N = 2), additive Runge-Kutta (ARK(sub 2)) methods from third- to fifth-order are presented that allow for integration of stiff terms by an L-stable, stiffly-accurate explicit, singly diagonally implicit Runge-Kutta (ESDIRK) method while the nonstiff terms are integrated with a traditional explicit Runge-Kutta method (ERK). Coupling error terms of the partitioned method are of equal order to those of the elemental methods. Derived ARK(sub 2) methods have vanishing stability functions for very large values of the stiff scaled eigenvalue, z[’] yields -infinity, and retain high stability efficiency in the absence of stiffness, z[’] yield 0. Extrapolation-type stage- value predictors are provided based on dense-output formulae. Optimized methods minimize both leading order ARK(sub 2) error terms and Butcher coefficient magnitudes as well as maximize conservation properties. Numerical tests of the new schemes on a CDR problem show negligible stiffness leakage and near classical order convergence rates. However, tests on three simple singular-perturbation problems reveal generally predictable order reduction. Error control is best managed with a PID-controller. While results for the fifth-order method are disappointing, both the new third- and fourth-order methods are at least as efficient as existing ARK(sub 2) methods.
Author
Additives; Convection-Diffusion Equation; Extrapolation; Runge-Kutta Method; Stiffness

20030031350 NASA Langley Research Center, Hampton, VA, USA
A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties
Bartels, Robert E., Elsevi; Computers and Structures; 2003; ISSN 0045-7949; Volume 81, pp. 349-357; In English; Copyright; Avail: Other Sources

A variable order method of integrating the structural dynamics equations that is based on the state transition matrix has been developed. The method has been evaluated for linear time variant and nonlinear systems of equations. When the time variation of the system can be modeled exactly by a polynomial it produces nearly exact solutions for a wide range of time step sizes. Solutions of a model nonlinear dynamic response exhibiting chaotic behavior have been computed. Accuracy of the method has been demonstrated by comparison with solutions obtained by established methods.
Author
Algorithms; Matrices (Mathematics); Nonlinear Systems; Dynamic Structural Analysis; Dynamic Response; Equations Of State

20030032206 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries
Choi, Dae-II; Brown, J. David; Imbiriba, Breno; Centrella, Joan; MacNeice, Peter; October 21, 2002; 45 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

We study the propagation of waves across fixed mesh refinement boundaries in linear and nonlinear model equations in 1-D and 2-D, and in the 3-D Einstein equations of general relativity. We demonstrate that using linear interpolation to set the

data in guard cells leads to the production of reflected waves at the refinement boundaries. Implementing quadratic interpolation to fill the guard cells eliminates these spurious signals.
Author
Wave Propagation; Nonlinear Equations; Grid Generation (Mathematics); Einstein Equations

65
STATISTICS AND PROBABILITY

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

20030022754 NASA Ames Research Center, Moffett Field, CA, USA
Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule
Bay, Stephen D.; Schwabacher, Mark; February 28, 2003; 10 pp.; In English; ACM International Conference on Knowledge Discovery and Data Mining, Aug. 24-27, 2003, Washington, D.C., USA
Contract(s)/Grant(s): NCC2-5496; No Copyright; Avail: CASI; A02, Hardcopy

Defining outliers by their distance to neighboring examples is a popular approach to finding unusual examples in a data set. Recently, much work has been conducted with the goal of finding fast algorithms for this task. We show that a simple nested loop algorithm that in the worst case is quadratic can give near linear time performance when the data is in random order and a simple pruning rule is used. We test our algorithm on real high-dimensional data sets with millions of examples and show that the near linear scaling holds over several orders of magnitude. Our average case analysis suggests that much of the efficiency is because the time to process non-outliers, which are the majority of examples, does not depend on the size of the data set.
Author
Linear Systems; Data Mining; Algorithms; Random Processes; Outliers (Statistics)

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

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

20030022666 NASA Ames Research Center, Moffett Field, CA, USA
Collectives for the Optimal Combination of Imperfect Objects
Tumer, Kagan; Wolpert, David; [2003]; 4 pp.; In English
Report No.(s): APS/123-QED; No Copyright; Avail: CASI; A01, Hardcopy

In this letter we summarize some recent theoretical work on the design of collectives, i.e., of systems containing many agents, each of which can be viewed as trying to maximize an associated private utility, where there is also a world utility rating the behavior of that overall system that the designer of the collective wishes to optimize. We then apply algorithms based on that work on a recently suggested testbed for such optimization problems. This is the problem of finding the combination of imperfect nano-scale objects that results in the best aggregate object. We present experimental results showing that these algorithms outperform conventional methods by more than an order of magnitude in this domain.
Author
Algorithms; Design Optimization; Machine Learning; Logic Programming; Mathematical Programming

67
THEORETICAL MATHEMATICS

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

20030025745 NASA Langley Research Center, Hampton, VA, USA
Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations
Alter, Stephen J.; [2003]; 15 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations
Report No.(s): AlAA Paper 2003-0952; No Copyright; Avail: CASI; A03, Hardcopy

A new technique for the control of grid line spacing and intersection angles of a structured volume grid, using elliptic

partial differential equations (PDEs) is presented. Existing structured grid generation algorithms make use of source term hybridization to provide control of grid lines, imposing orthogonality implicitly at the boundary and explicitly on the interior of the domain. A bridging function between the two types of grid line control is typically used to blend the different orthogonality formulations. It is shown that utilizing such a bridging function with source term hybridization can result in the excessive use of computational resources and diminishes robustness. A new approach, Anisotropic Lagrange Based Trans-Finite Interpolation (ALBTFI), is offered as a replacement to source term hybridization. The ALBTFI technique captures the essence of the desired grid controls while improving the convergence rate of the elliptic PDEs when compared with source term hybridization. Grid generation on a blunt cone and a Shuttle Orbiter is used to demonstrate and assess the ALBTFI technique, which is shown to be as much as 50\% faster, more robust, and produces higher quality grids than source term hybridization.
Author
Algorithms; Structured Grids (Mathematics); Grid Generation (Mathematics); Elliptic Differential Equations; Hypersonic Flow; Robustness (Mathematics); Computational Grids

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*.

20030025299 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Effective Frequency Technique
Kirk, C. Laurence; Weng, Chi Y.; Journal of the Optical Society of America; [2002]; 16 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

An effective monochromatic frequency technique is described to represent the effects of finite spectral bandwidth for active and passive measurements centered on an absorption line, a trough region, or a slowly varying spectral feature. For Gaussian and rectangular laser line shapes, the effective frequency is shown to have a simple form which depends only on the instrumental line shape and bandwidth and not on the absorption line profile. The technique yields accuracies better than 0.1\% for bandwidths less than 0.2 times the atmospheric line width.
Author
Frequencies; Line Spectra; Bandwidth; Shapes

20030025340 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA)
Taylor, Patrick T.; Kim, Hyung Rae; vonFrese, Ralph R. B.; Potts, Laramie V.; Frawley, James J.; [2003]; 4 pp.; In English; Orsted 4 Meetings, Denmark; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-7645; Copyright; Avail: CASI; A01, Hardcopy

With the successful launch of the Orsted, SAC-C and CHAMP satellites we are able to make both magnetic and gravity anomaly maps of the Earth's crust; magnetic from all three missions and gravity with CHAMP. We have used these data to study the KMA area of Russia. This is an important region for several reasons: (1) we have already made satellite magnetic anomaly maps of this region and they can be integrated with the gravity data from CHAMP for a comprehensive interpretation; (2) KMA contains the largest know reserves of iron-ore in the world; and (3) there are significant ground truth data available for this region from aeromagnetic, balloon surveys and geophysical mapping, including extensive rock magnetic/paleo-magnetic and geologic studies. Utilizing the gravity observations, collocated with the magnetic data enabled us to make a joint interpretation. While there is a high amplitude magnetic anomaly recorded over the KMA the gravity anomaly at satellite altitude revealed by CHAMP is only around 3-6 mGal but is not centered on the magnetic high. This would indicate that despite the fact that in the region of the KMA the rocks have a higher percentage of iron than in the surrounding formations the entire area is Archean-Proterozoic in age and therefore very dense.
Author
Magnetic Fields; Magnetic Surveys; Magnetic Anomalies; Mapping; Gravity Anomalies; Russian Federation

71
ACOUSTICS

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

20030025699 Defence Science and Technology Organisation, Edinburgh, Australia
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing
Bertilone, Derek; Killeen, Damien; October 2002; 27 pp.; In English; Original contains color illustrations
Report No.(s): DSTO-TR-1357; DODA-AR-012-483; Copyright; Avail: Other Sources

Impulsive noise interference of a biological origin is common in underwater acoustic environments. Here we report on properties of impulsive noise produced by sperm whales, recorded in deep water off the coast of Manus Island. We analyse the noise as a function of frequency band, and find strong non-Gaussian effects in the range 1-6 kHz. Sonar performance can be improved by utilising nonlinear filtering techniques from non- Gaussian detection theory. We demonstrate this by measuring empirical gains for a constant false-alarm rate (CFAR) incoherent narrowband processor. We investigate both parametric locally optimum and nonparametric filtering of the time-domain data to enhance weak signal detection. Simulated Rayleigh fading signals were inserted into the noise data, and the detection threshold was found to be lowered by about 4 dB over conventional processing, for signal frequencies 1.5 kHz and 4.5 kHz and a false-alarm probability of 0.0001. Performance degradations can potentially occur at large signal-to-noise ratios, but these were mitigated using a simple technique for fusing the non-Gaussian processor with a conventional processor
Author
Sonar; Signal Processing; Whales; Underwater Acoustics; Noise (Sound); Signal To Noise Ratios; Design Optimization; Interference

20030032214 NASA Glenn Research Center, Cleveland, OH, USA
Recent Progress in Engine Noise Reduction Technologies
Huff, Dennis; Gliebe, Philip; [2003]; 72 pp.; In English; 41st AIAA Aerospace Sciences Meeting, 6-9 Jan. 2003; Original contains color illustrations
Contract(s)/Grant(s): WBS 22-781-30-12; Copyright; Avail: CASI; A04, Hardcopy

Highlights from NASA-funded research over the past ten years for aircraft engine noise reduction are presented showing overall technical plans, accomplishments, and selected applications to turbofan engines. The work was sponsored by NASA's Advanced Subsonic Technology (AST) Noise Reduction Program. Emphasis is given to only the engine noise reduction research and significant accomplishments that were investigated at Technology Readiness Levels ranging from 4 to 6. The Engine Noise Reduction sub-element was divided into four work areas: source noise prediction, model scale tests, engine validation, and active noise control. Highlights from each area include technologies for higher bypass ratio turbofans, scarf inlets, forward-swept fans, swept and leaned stators, chevron/tabbed nozzles, advanced noise prediction analyses, and active noise control for fans. Finally, an industry perspective is given from General Electric Aircraft Engines showing how these technologies are being applied to commercial products. This publication contains only presentation vu-graphs from an invited lecture given at the 41st AIAA Aerospace Sciences Meeting, January 6-9, 2003.
Author
Active Control; Aircraft Engines; Engine Noise; Noise Reduction; Technology Assessment; Scale Models; Performance Tests

74
OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

20030025261 Energy Solutions International, LLC, Gaithersburg, MD, USA
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly
Cleveland, Paul E.; Buchko, Matthew T.; Stavely, Richard A.; Simpson, Alda, Technical Monitor; October 29, 2002; 2 pp.; In English; 33rd International Conference on Environmental Systems (ICES), 7-10 Jul. 2003, Vancouver, B.C., Canada; No Copyright; Avail: Other Sources; Abstract Only

The Hubble Space Telescope (HST) is one of NASA s premier astronomical observatories. A unique design feature of the

spacecraft is its capacity to be serviced and refurbished on-orbit. Repairs to the HST are made during events called Servicing Missions (SM). The SM consists of several phases that include: shuttle launch, ascent, rendezvous with HST, grapple, Extra Vehicular Activity (EVA) servicing, redeployment of the HST, shuttle entry and landing. The purpose of a SM is to upgrade the HST scientific capabilities and to repair or replace failed equipment. The benefit of the SM is to enhance the scientific capability of the HST and to extend its operational lifetime to a decade or more. Extra Vehicular Activity (EVA) days, the crew will replace the Wide Field Planetary Camera II (WFPCII) with the Wide Field Camera 3 (WFC3). The HST slot for these instruments is the '-V3 Radial Instrument' position. Servicing Mission 4 (SM-4) is currently scheduled for Spring 2005. During one of the five The WFC3 contains both Ultraviolet and Infrared detectors. Due to the differing thermal requirements for these items and their associated assemblies, the WFC3 contains several thermal subsystems within the instrument enclosure. One of these subsystems is the Variable Conductance Heat Pipe (VCHP) assembly. contains an integral constant conductance heat pipe (CCHP); a variable conductance heat pipe (VCHP); and a VCHP reservoir radiator (offset from the main WFC3 external radiator). The VCHP condenser utilizes the main WFC3 external radiator to reject its heat to space. The WFC3 VCHP assembly consists of the Optical Bench Cold Plate (OBCP), which The primary challenge for the VCHP assembly is to maintain the OBCP at -5 C +/- 2 C for various heat loads while subject to a 90-minute orbit cycling environment which ranges from 0 C to -143 C. Key components that provide active control include a 10 W heater system, the reservoir, and a proportional controller. This paper summarizes the overall thermal vacuum test program for the VCHP assembly. This includes performance during the 90-minute orbit cycling case, maximum capacity case, and cold system shut down case. The test was conducted in Building 7, Chamber #237 at the NASA/Goddard Space Flight Center. It lasted approximately fourteen days, from 5-28-02 to 6-10-02. Included in this paper is a comparison of the results with thermal model temperature predictions.
Author
Active Control; Cameras; Conductive Heat Transfer; Infrared Detectors; Thermal Vacuum Tests; Ultraviolet Detectors

20030025382 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Holographic Optical Elements as Scanning Lidar Telescopes
Schwemmer, Geary K.; Rallison, Richard D.; Wilkerson, Thomas D.; Guerra, David V.; [2003]; 53 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A04, Hardcopy

We have investigated and developed the use of holographic optical elements (HOE) and holographic transmission gratings for scanning lidar telescopes. By rotating a flat HOE in its own plane with the focal spot on the rotation axis, a very simple and compact conical scanning telescope is possible. We developed and tested transmission and reflection HOES for use with the first three harmonics of Nd:YAG lasers, and designed, built, and tested two lidar systems based on this technology.
Author
Holographic Optical Elements; Conical Scanning; Optical Radar; Telescopes; Optical Filters

20030025394 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Changes in Earth 360 380 nm Reflectivity: 1980 2000
Herman, J. R.; Ziemke, G.; Larko, D.; September 2002; 1 pp.; In English; SPIE Remote Sensing Symposium, 23-27 Oct. 2002, Hangzhou, China; No Copyright; Avail: Other Sources; Abstract Only

The Total Ozone Mapping Spectrometer (TOMS) reflectivity time series 1980 to 1992 and 1997 to 2000 have been combined to estimate change that have occurred over a 21 year period. The relative calibration of the two TOMS (Nimbus-7, N7 and Earth-Probe, EP) has been adjusted using the measured minimum reflectivity over mid-latitude ocean and land locations (50o). The result is that the N7 reflectivity has been decreased by 0.02 to match the better-calibrated Earth-Probe/TOMS. Most of the local trend features seen in the N7 time series (1980 to 1992) have been continued in the combined time series, but the overall zonal average and global trends have changed. The correlation of cloud cover with solar activity (measured by the 10.7 cm solar radiation) that was present during the Nimbus-7 period (1980 to 1992) is no longer evident for the period 1980 to 2000. The UV reflectivity data are compared with changes in the Advanced Very High Resolution Radiometer (AVHRR) Outgoing Long-wavelength Radiation (OLR) and show an expected anti-correlation with cloud-cover changes over the same period for many, but not all, features. The key results include a continuing decrease in cloud cover over Europe and North America and an increase in reflectivity near climatology should be reduced by 0.02. The TOMS reflectivity time series 1980 to 1992 and 1997 to 2000 have been Antarctica. This also means that the previously published N7 UV surface reflectivity.
Author
Advanced Very High Resolution Radiometer; Calibrating; Cloud Cover; Correlation; Position (Location); Reflectance; Solar Activity; Temperate Regions; Total Ozone Mapping Spectrometer

20030025751 NASA Langley Research Center, Hampton, VA, USA
Response Surface Methods For Spatially-Resolved Optical Measurement Techniques
Danehy, P. M.; Dorrington, A. A.; Cutler, A. D.; DeLoach, R.; January 09, 2003; 17 pp.; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains color illustrations
Report No.(s): AI AA Paper 2003-0648; Copyright; Avail: CASI; A03, Hardcopy

Response surface methods (or methodology), RSM, have been applied to improve data quality for two vastly different spatially-resolved optical measurement techniques. In the first application, modern design of experiments (MDOE) methods, including RSM, are employed to map the temperature field in a direct-connect supersonic combustion test facility at NASA Langley Research Center. The laser-based measurement technique known as coherent anti-Stokes Raman spectroscopy (CARS) is used to measure temperature at various locations in the combustor. RSM is then used to develop temperature maps of the flow. Even though the temperature fluctuations at a single point in the flowfield have a standard deviation on the order of 300 K, RSM provides analytic fits to the data having 95\% confidence interval half width uncertainties in the fit as low as +/- 30 K. Methods of optimizing future CARS experiments are explored. The second application of RSM is to quantify the shape of a 5-meter diameter, ultra-lightweight, inflatable space antenna at NASA Langley Research Center. Photogrammetry is used to simultaneously measure the shape of the antenna at approximately 500 discrete spatial locations. RSM allows an analytic model to be developed that describes the shape of the majority of the antenna with an uncertainty of 0.4 mm, with 95\% confidence. This model would allow a quantitative comparison between the actual shape of the antenna and the original design shape. Accurately determining this shape also allows confident interpolation between the measured points. Such a model could, for example, be used for ray tracing of radio-frequency waves up to 95 GHz. to predict the performance of the antenna.
Author
Optical Measurement; Raman Spectroscopy; Experiment Design; Mathematical Models; Data Processing; Antenna Design

76
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*.

20030020938 NASA Glenn Research Center, Cleveland, OH, USA
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation
Alterovitz, S. A.; Mueller, C. H.; Croke, E. T.; February 10, 2003; 13 pp.; In English
Contract(s)/Grant(s): WBS 22-274-00-0105
Report No.(s): E-13864; Copyright; Avail: CASI; A03, Hardcopy

High mobility n-type SiGe/Si transistor structures have been fabricated on sapphire substrates by ion implanting phosphorus ions into strained 100 Angstrom thick silicon channels for the first time. The strained Si channels were sandwiched between Si(sub 0.7)Ge(sub 0.3) layers, which, in turn, were deposited on Si(sub 0.7)Ge(sub 0.3) virtual substrates and graded SiGe buffer layers. After the molecular beam epitaxy (MBE) film growth process was completed, ion thick silicon channels implantation and post-annealing were used to introduce donors. The phosphorous ions were preferentially located in the Si channel at a peak concentration of approximately 1x10(exp 18)/cu cm. Room temperature electron mobilities exceeding 750 sq cm/V-sec at carrier densities of 1x10(exp 12)/sq cm were measured. Electron concentration appears to be the key factor that determines mobility, with the highest mobility observed for electron densities in the 1 - 2x10(exp 12)/sq cm range.
Author
Electron Mobility; Ion Implantation; Molecular Beam Epitaxy; High Electron Mobility Transistors; Sos (Semiconductors); Silicon Films; Sapphire

20030022682 NASA Glenn Research Center, Cleveland, OH, USA
Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings
Nesbitt, James A.; Zhu, Dongming; Miller, Robert A.; Barrett, Charles A.; [2002]; 22 pp.; In English; 5th International Conference on Microscopy of Oxidation, 26-28 Aug. 2002, Republic of Ireland, Ireland; Original contains black and white illustrations
Contract(s)/Grant(s): RTOP 714-04-20; No Copyright; Avail: CASI; A03, Hardcopy

Advanced and baseline thermal barrier coatings (TBCs) were thermal cycle tested in air at 1163 C until delamination or spallation of the ceramic top coat. The top coat of the advanced TBC s consisted of ZrO2 with various amounts of Y2O3,

Yb2O3, Gd2O3, or Nd2O3 dopants. The composition of the top coat of the baseline TBC was ZrO2-8wt.%Y2O3. All top coats were deposited by air plasma spraying. A NiCrAlY or NiCoCrAlY bond coat was deposited by low pressure plasma spraying onto a single-crystal, Ni-base superalloy. The TBC lifetime for the baseline coatings was approximately 190 cycles (45 minutes at 1163 C per cycle) while the lifetime for the advanced coatings was as high as 425 cycles. The fracture surfaces and sample cross sections were examined after TBC failure by SEM and optical microscopy, and the top coats were further examined by X-ray diffraction. These post-test studies revealed that the fracture path largely followed splat boundaries with some trans-splat fracture. However, there were no obvious distinguishing features which explained the difference in TBC lifetimes between some of the advanced and baseline coatings.
Author
Cycles; Failure; Morphology; Zirconium Oxides; Thermal Control Coatings; X Ray Diffraction

20030022748 NASA Glenn Research Center, Cleveland, OH, USA
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers
Neudeck, Philip G.; Powell, J. Anthony; Beheim, Glenn M.; Benavage, Emye L.; Abel, Phillip B.; Trunek, Andrew J.; Spry, David J.; Dudley, Michael; Vetter, William M.; Journal of Applied Physics; September 01, 2002; ISSN 0021-8979; Volume 92, No. 5, pp. 2391-2400; In English; Original contains black and white illustrations
Contract(s)/Grant(s): 704-30-53; Copyright; Avail: Other Sources

Lateral homoepitaxial growth of thin cantilevers emanating from mesa patterns that were reactive ion etched into on-axis commercial SiC substrates prior to growth is reported. The thin cantilevers form after pure stepflow growth removes almost all atomic steps from the top surface of a mesa, after which additional adatoms collected by the large step-free surface migrate to the mesa sidewall where they rapidly incorporate into the crystal near the top of the mesa sidewall. The lateral propagation of the step-free cantilevered surface is significantly affected by pregrowth mesa shape and orientation, with the highest lateral expansion rates observed at the inside concave comers of V-shaped pregrowth mesas with arms lengthwise oriented along the {1100} direction. Complete spanning of the interiors of V's and other mesa shapes with concave comers by webbed cantilevers was accomplished. Optical microscopy, synchrotron white beam x-ray topography and atomic force microscopy analysis of webbed regions formed over a micropipe and closed-core screw dislocations show that c-axis propagation of these defects is terminated by the webbing. Despite the nonoptimized process employed in this initial study, webbed surfaces as large as 1.4 x 10(exp -3) square centimeters, more than four times the pregrowth mesa area, were grown. However, the largest webbed surfaces were not completely free of bilayer steps, due to unintentional growth of 3C-SiC that occurred in the nonoptimized process. Further process optimization should enable larger step-free webs to be realized.
Author
Silicon Carbides; Epitaxy; Crystal Growth; Semiconductor Devices; Cantilever Beams; Thin Films; Expansion

20030022759 NASA Ames Research Center, Moffett Field, CA, USA
The Anharmonic Force Field of BeH2 Revisited
Martin, Jan M. L.; Lee, Timothy J.; [2003]; 9 pp.; In English; High Accuracy Potentials for Quantum Dynamics, 31 Mar. - 2 Apr. 2003, London, UK
Contract(s)/Grant(s): RTOP 713-74-10; Copyright; Avail: CASI; A02, Hardcopy

The anharmonic force field of BeH2 has been calculated near the basis set and n-particle space limits. The computed antisymmetric stretch frequencies of BeH2 and BeD2 are in excellent agreement with recent high-resolution gas-phase measurements. The agreement between theory and experiment for the other spectroscopic constants is also excellent, except for omega(sub 3) and X(sub 33) for BeH2 and G(sub 22) for BeD2. It is concluded that further experimental work is needed in order to resolve these discrepancies.
Author
Field Theory (Physics); Computation; Symmetry

20030022766 Computer Sciences Corp., Moffett Field, CA, USA NASA Ames Research Center, Moffett Field, CA, USA
Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption
Li, Jian-Zhong; Kolokolov, Kanstantin I.; Ning, Cun-Zheng; January 2003; 17 pp.; In English; Photonics West 2003, 25-31 Jan. 2003, San Jose, CA, USA
Contract(s)/Grant(s): RTOP 704-05-40; No Copyright; Avail: CASI; A03, Hardcopy

Linear absorption spectra arising from intersubband transitions in semiconductor quantum well heterostructures are

analyzed using quantum kinetic theory by treating correlations to the first order within Hartree-Fock approximation. The resulting intersubband semiconductor Bloch equations take into account extrinsic dephasing contributions, carrier-longitudinal optical phonon interaction and carrier-interface roughness interaction which is considered with Ando s theory. As input for resonance lineshape calculation, a spurious-states-free 8-band kp Hamiltonian is used, in conjunction with the envelop function approximation, to compute self-consistently the energy subband structure of electrons in type II InAs/AlSb single quantum well structures. We demonstrate the interplay of nonparabolicity and many-body effects in the mid-infrared frequency range for such heterostructures.
Author
Semiconductors (Materials); Quantum Wells; Numerical Analysis; Absorption Spectra; Mathematical Models; Optoelectronic Devices; Microscopy

20030031372 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI)
Jhabvala, M.; Gunapala, S.; Reuter, D.; Cho, K. K.; Bandara, S.; Liu, J.; La, A.; Banks, S.; Cho, J.; Hwang, T.; October 2002; 16 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

A viewgraph presentation on the development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) is provided. The topics include: 1) Background and Project Goals; 2) Instrument Overview; 3) Subassembly Description; 4) Operating Conditions; 5) Current System Performance Status; and 6) Near-Term Improvements.
CASI
Gallium Arsenides; Infrared Radiation; Fabrication; Imaging Techniques; Quantum Wells; Photometers

20030032211 NASA Glenn Research Center, Cleveland, OH, USA
High-Temperature Electronics: A Role for Wide Bandgap Semiconductors?
Neudeck, Philip G.; Okojie, Robert S.; Chen, Liang-Yu, Instit; Proceedings of the IEEE; June 2002; ISSN 0018-9219; Volume 90, No. 6, pp. 1065-1076; In English; Original contains black and white illustrations
Contract(s)/Grant(s): RTOP 714-07-30
Report No.(s): E-13637; Copyright; Avail: CASI; A03, Hardcopy

It is increasingly recognized that semiconductor based electronics that can function at ambient temperatures higher than 150 C without external cooling could greatly benefit a variety of important applications, especially-in the automotive, aerospace, and energy production industries. The fact that wide bandgap semiconductors are capable of electronic functionality at much higher temperatures than silicon has partially fueled their development, particularly in the case of SiC. It appears unlikely that wide bandgap semiconductor devices will find much use in low-power transistor applications until the ambient temperature exceeds approximately 300 C, as commercially available silicon and silicon-on-insulator technologies are already satisfying requirements for digital and analog very large scale integrated circuits in this temperature range. However, practical operation of silicon power devices at ambient temperatures above 200 C appears problematic, as self-heating at higher power levels results in high internal junction temperatures and leakages. Thus, most electronic subsystems that simultaneously require high-temperature and high-power operation will necessarily be realized using wide bandgap devices, once the technology for realizing these devices become sufficiently developed that they become widely available. Technological challenges impeding the realization of beneficial wide bandgap high ambient temperature electronics, including material growth, contacts, and packaging, are briefly discussed.
Author
Semiconductor Devices; Soi (Semiconductors); Silicon Carbides; Energy Gaps (Solid State); Field Effect Transistors; High Temperature

77
PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry.*

20030025300 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV
Kazanas, D.; Georganopoulos, M.; Mastichladis, A.; January 24, 2003; 4 pp.; In English; 2003 High Energy Astrophysics Division (HEAD), 1 Jan. 2003; Original Document is of poor quality; No Copyright; Avail: Other Sources; Abstract Only

We propose a process by which the kinetic energy of the protons, that carry most of the energy of GRB relativistic blast waves (RBW) of Lorentz factor is converted explosively into relativistic electrons of the same Lorentz factor, which subsequently produce the observed prompt gamma-ray emission of the burst. This conversion is the result of the combined effects of the reflection of photons produced within the flow by upstream located matter, their re-interception and conversion into e(+) e(-) pairs on the RBW by the p gamma (right arrow) p e(+) e(-) reaction.
Author
Gamma Ray Bursts; High Energy Electrons; Proton Energy; Relativistic Particles; Models

20030031354 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Production of Pions in pA-collisions
Moskalenko, I. V.; Mashnik, S. G.; March 27, 2003; 1 pp.; In English; 28th ICRC Meeting, 31 Jul. - 7 Aug. 2003, Japan; Copyright; Avail: Other Sources; Abstract Only

Accurate knowledge of pion production cross section in PA-collisions is of interest for astrophysics, CR physics, and space radiation studies. Meanwhile, pion production in pA-reactions is often accounted for by simple scaling of that for pp-collisions, which is not enough for many real applications. We evaluate the quality of existing parameterizations using the data and simulations with the Los Alamos version of the Quark-Gluon String Model code LAQGSM and the improved Cascade-Exciton Model code CEM2k. The LAQGSM and CEM2k models have been shown to reproduce well nuclear reactions and hadronic data in the range 0.01-800 GeV/nucleon.
Author
Pions; Cross Sections; Particle Collisions; String Theory

20030032182 NASA Goddard Space Flight Center, Greenbelt, MD, USA
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications
Mashnik, S. G.; Gudima, K. K.; Sierk, A. J.; Moskalenko, I. V.; [2002]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Space radiation shield applications and studies of cosmic ray propagation in the Galaxy require reliable cross sections to calculate spectra of secondary particles and yields of the isotopes produced in nuclear reactions induced both by particles and nuclei at energies from threshold to hundreds of GeV per nucleon. Since the data often exist in a very limited energy range or sometimes not at all, the only way to obtain an estimate of the production cross sections is to use theoretical models and codes. Recently, we have developed improved versions of the Cascade-Exciton Model (CEM) of nuclear reactions: the codes CEM97 and CEM2k for description of particle-nucleus reactions at energies up to about 5 GeV. In addition, we have developed a LANL version of the Quark-Gluon String Model (LAQGSM) to describe reactions induced both by particles and nuclei at energies up to hundreds of GeVhucleon. We have tested and benchmarked the CEM and LAQGSM codes against a large variety of experimental data and have compared their results with predictions by other currently available models and codes. Our benchmarks show that CEM and LAQGSM codes have predictive powers no worse than other currently used codes and describe many reactions better than other codes; therefore both our codes can be used as reliable event-generators for space radiation shield and cosmic ray propagation applications. The CEM2k code is being incorporated into the transport code MCNPX (and several other transport codes), and we plan to incorporate LAQGSM into MCNPX in the near future. Here, we present the current status of the CEM2k and LAQGSM codes, and show results and applications to studies of cosmic ray propagation in the Galaxy.
Author
Cosmic Rays; Extraterrestrial Radiation; Galaxies; Mathematical Models; Nuclear Reactions; Propagation; Computer Programs

80
SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula. For specific topics in these areas see *categories 81 through 85*.

20030020940 NASA Glenn Research Center, Cleveland, OH, USA
Science Through ARts (STAR)
Kolecki, Joseph; Petersen, Ruth; Williams, Lawrence; [2002]; 4 pp.; In English
Contract(s)/Grant(s): RTOP 332-41-00
Report No.(s): E-13629; Copyright; Avail: CASI; A01, Hardcopy

Science Through ARts (STAR) is an educational initiative designed to teach students through a multidisciplinary approach to learning. This presentation describes the STAR pilot project, which will use Mars exploration as the topic to be integrated. Schools from the UK, Japan, the USA, and possibly eastern Europe are expected to participate in the pilot project.
CASI
Education; Learning; Students

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20030025344 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Technology Transfer/Commercialization Report
[2002]; 30 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Contents include the following: (1) Who we are. (2) Technology opportunities and successes in 2002: Hilbert-Huang transform; new sensors via sol-gel-filled fiber optics; hierarchical segmentation software. (3) Activities in 2002: encouraging researcher involvement; inventorying new technologies; patenting Goddard technologies; promoting Goddard technologies; establishing new agreements;seeking and bestowing awards. (4) How to reach Goddard's: technology commercialization office.
Derived from text
Commercialization; Sol-Gel Processes; Technology Transfer; Technology Utilization

20030025438 NASA Goddard Space Flight Center, Greenbelt, MD, USA QSS Group, Inc., Seabrook, MD, USA
Systems Engineering Education Development(SEED)Case Study
Bagg, Thomas C., III; Brumfield, Mark D.; Jamison, Donald E.; Granata, Raymond L.; Casey, Carolyn A.; July 2003; 8 pp.; In English; Thirteenth Annual International Council on Systems Engineering Symposium, 1 - 3 Jul. 2003, Crystal City, VA, USA; Copyright; Avail: CASI; A02, Hardcopy

The Systems Engineering Development Program (SEED) was initiated to help Goddard resolve a Systems Engineering skill shortage. The chronology of events and the experiences of the pilot program are outlined to describe the development of the present program. The program goals are included in order to give a focus on what the developers saw as the program drivers. Lessons learned from a pilot program were incorporated into the present program. This program is constantly learning from its past efforts and looks for continuous improvement. We list several future ideas for improvement and change.
Author
Systems Engineering; Education; NASA Programs; Personnel Development; Leadership

20030031331 NASA Kennedy Space Center, Cocoa Beach, FL, USA
Task Analysis Technologies at KSC
Carstens, Deborah S.; January 2003; 18 pp.; In English; Applied Ergonomics Conference 2003, 10-13 Mar. 2003, Dallas, TX, USA; Original contains black and white illustrations
Report No.(s): KSC-2003-008; No Copyright; Avail: CASI; A03, Hardcopy

Project objective: (1) Form an integrated team of NASA. USA, Boeing, and Dynacs researches. (2) Create a user friendly software prototype that assists an analyst in performing a human factors process failure modes and effects analysis (HF-PFMEA). (3)Perform four task analyses on center: cargo late access task analysis (NASA/Boeing team); payload test and verification system task analysis (NASA/Boeing team); slammer cover installation operations task analysis (NASA/USA team); ATDC LOX pump acceptance test procedure task analysis (NASA/Dynacs team).
Derived from text
Management Planning; Computer Programs; Failure Modes

82
DOCUMENTATION AND INFORMATION SCIENCE

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

20030020867 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
US Astronomers Access to SIMBAD in Strasbourg, France
Eichhorn, G.; Oliverson, Ronald J., Technical Monitor; March 2003; 2 pp.; In English
Contract(s)/Grant(s): NAG5-8413; No Copyright; Avail: CASI; A01, Hardcopy

During the last year the US SIMBAD Gateway Project continued to provide services like user registration to the US users of the SIMBAD database in France. Currently there are over 4300 US users registered. We also provided user support by answering questions from users and handling requests for lost passwords when still necessary. Even though almost all users now access SIMBAD without a password, based on hostnames/IP addresses, there are still some users that need individual passwords. We continued to maintain the mirror copy of the SIMBAD database on a server at SAO. This allows much faster access for the US users. During the past year we moved this mirror to a faster server to improve access for the US users. We again supported a demonstration of the SIMBAD database at the meeting of the American Astronomical Society in January. We provided support for the demonstration activities at the SIMBAD booth. We paid part of the fee for the SIMBAD demonstration. We continued to improve the cross-linking between the SIMBAD project and the Astrophysics Data System. This cross-linking between these systems is very much appreciated by the users of both the SIMBAD database and the ADS Abstract Service. The mirror of the SIMBAD database at SAO makes this connection faster for the US astronomers. We exchange information between the ADS and SIMBAD on a daily basis. The close cooperation between the CDS in Strasbourg and SAO, facilitated by this project, is an important part of the astronomy-wide digital library initiative. It has proven to be a model in how different data centers can collaborate and enhance the value of their products by linking with other data centers. We continue this collaboration in order to provide better services to both the US and European astronomical community. This collaboration is even more important in light of the developments for the Virtual Observatory projects in the different countries.
Author
Astronomy; International Cooperation; Data Bases; Internet Resources

83
ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

20030020952 NASA Ames Research Center, Moffett Field, CA, USA Computer Sciences Corp., USA
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore
Nakai, Junko; VanDerWijngaart, Rob F.; January 09, 2003; 38 pp.; In English; IPG Workshop, Feb. 2002, Palo Alto, CA, USA
Contract(s)/Grant(s): RTOP 704-40-24; No Copyright; Avail: CASI; A03, Hardcopy

Markets are often considered superior to other global scheduling mechanisms for distributed computing systems. This claim is supported by: a casual observation from our every-day life that markets successfully equilibrate supply and demand, and the features of markets which originate in the general equilibrium theory, e.g., efficiency and the lack of necessity of 2 central controller. This paper describes why such beliefs in markets are not warranted. It does so by examining the general equilibrium theory, in terms of scope, abstraction, and interpretation. Not only does the general equilibrium theory fail to provide a satisfactory explanation of actual economies, including a computing-resource economy, it also falls short of supplying theoretical foundations for commonly held views of market desirability. This paper also points out that the argument for the desirability of markets involves circular reasoning and that the desirability can be established only vis-a-vis a scheduling goal. Finally, recasting the conclusion of Arrow's Impossibility Theorem as that for global scheduling, we conclude that there exists no market-based scheduler that is rational (in the sense defined in microeconomic theory), takes into account utility of more than one user, and yet yields a Pareto-optimal outcome for arbitrary user utility functions.
Author
Market Research; Economic Analysis; Distributed Processing; Programming (Scheduling); Computer Networks; Optimization

85
TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety, 16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

20030025367 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Nature of the UV/X-ray Absorber In PG 2302+029

Sabra, Bassem M.; Hamann, Fred; Jannuzi, Buell T.; George, Ian M.; Shields, Joseph C.; [2003]; 12 pp.; In English; Original document is cut off on top of several pages.

Contract(s)/Grant(s): NAS5-26555; GO-07348.01-A; GO-0-1123X; GO-0-1157X; Copyright; Avail: CASI; A03, Hardcopy

We present Chandra X-ray observations of the radio-quiet QSO PG 2302+029. This quasar has a rare system of ultra-high velocity (-56,000 km s(exp -1) UV absorption lines that form in an outflow from the active nucleus. The Chandra data indicate that soft X-ray absorption is also present. We perform a joint UV and X-ray analysis, using photoionization calculations, to determine the nature of the absorbing gas. The UV and X-ray datasets were not obtained simultaneously. Nonetheless, our analysis suggests that the X-ray absorption occurs at high velocities in the same general region as the UV absorber. There are not enough constraints to rule out multi-zone models. In fact, the distinct broad and narrow UV line profiles clearly indicate that multiple zones are present. Our preferred estimates of the ionization and total column density in the X-ray absorber (logU = 1.6, N(sub eta) = 10(exp 22.4) cm (exp -2) over predict the O VI lambda lambda1032,1038 absorption unless the X-ray absorber is also outflowing at approximately 56,000 km s(exp-l), but they over predict the Ne VIII lambda lambda 770,780 absorption at all velocities. If we assume that the X-ray absorbing gas is outflowing at the same velocity of the UV-absorbing wind and that the wind is radiatively accelerated, then the outflow must be launched at a radius of less than or equal to 10(exp 15) cm from the central continuum source. The smallness of this radius casts doubts on the assumption of radiative acceleration.

Author

X Ray Absorption; Ultraviolet Absorption; Quasars; Absorption Spectra; Active Galaxies; X Ray Analysis; Stellar Structure

88
SPACE SCIENCES (GENERAL)

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

20030021664 NASA Ames Research Center, Moffett Field, CA, USA Research Inst. for Advanced Computer Science, Moffett Field, CA, USA

Modeling and Simulation for Mission Operations Work System Design

Sierhuis, Maarten; Clancey, William J.; Seah, Chin; Trimble, Jay P.; Sims, Michael H.; January 2003; 78 pp.; In English

Contract(s)/Grant(s): NCC2-1006; No Copyright; Avail: CASI; A05, Hardcopy

Work System analysis and design is complex and non-deterministic. In this paper we describe Brahms, a multiagent modeling and simulation environment for designing complex interactions in human-machine systems. Brahms was originally conceived as a business process design tool that simulates work practices, including social systems of work. We describe our modeling and simulation method for mission operations work systems design, based on a research case study in which we used Brahms to design mission operations for a proposed discovery mission to the Moon. We then describe the results of an actual method application project-the Brahms Mars Exploration Rover. Space mission operations are similar to operations of traditional organizations; we show that the application of Brahms for space mission operations design is relevant and transferable to other types of business processes in organizations.

Author

Systems Engineering; Mathematical Models; Space Missions; Environment Simulation; Man Machine Systems

89
ASTRONOMY

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

20030022683 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Interstellar Antifreeze: Ethylene Glycol

Hollis, J. M.; Lovas, F. J.; Jewell, P. R.; Coudert, L. H., Americ; The Astrophysical Journal; May 20, 2002; Volume 571, pp. L59 - L62; In English

Contract(s)/Grant(s): NSF AST-99-81363; RTOP 344-02-03-01; Copyright; Avail: CASI; A01, Hardcopy

Interstellar ethylene glycol (HOCH2CH2,OH) has been detected in emission toward the Galactic center source Sagittarius B2(N-LMH) by means of several millimeter-wave rotational torsional transitions of its lowest energy conformer. The types and kinds of molecules found to date in interstellar clouds suggest a chemistry that favors aldehydes and their corresponding reduced alcohols-e.g., formaldehyde (H2CO)/methanol (CH3OH), acetaldehyde (CH3CHO)/ethanol (CH3CH2OH). Similarly, ethylene glycol is the reduced alcohol of glycolaldehyde (CH2OHCHO), which has also been detected toward Sgr B2(N-LMH). While there is no consensus as to how any such large complex molecules are formed in the interstellar clouds, atomic hydrogen (H) and carbon monoxide (CO) could form formaldehyde on grain surfaces, but such surface chemistry beyond that point is uncertain. However, laboratory experiments have shown that the gas-phase reaction of atomic hydrogen (H) and solid-phase CO at 10-20 K can produce formaldehyde and methanol and that alcohols and other complex molecules can be synthesized from cometary ice analogs when subject to ionizing radiation at 15 K. Thus, the presence of aldehyde/reduced alcohol pairs in interstellar clouds implies that such molecules are a product of a low-temperature chemistry on grain surfaces or in grain ice mantles. This work suggests that aldehydes and their corresponding reduced alcohols provide unique observational constraints on the formation of complex interstellar molecules.

Author

Ethyl Alcohol; Molecular Clouds; Interstellar Matter; Ethylene Compounds; Glycols; Chemical Reactions

20030022712 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries

Titarchuk, Lev; [2002]; 16 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Accretion onto compact objects in X-ray binaries (black hole, neutron star (NS), white dwarf) is characterized by non-uniform flow density profiles. Such an effect of heterogeneity in presence of gravitational forces and pressure gradients exhibits Rayleigh-Taylor gravity waves (RTGW). They should be seen as quasiperiodic wave oscillations (QPO) of the accretion flow in the transition (boundary) layer between the Keplerian disk and the central object. In this paper the author shows that the main QPO frequency, which is very close to the Keplerian frequency, is split into separate frequencies (hybrid and low branch) under the influence of the gravitational forces in the rotational frame of reference. The RTGWs must be present and the related QPOs should be detected in any system where the gravity, buoyancy and Coriolis force effects cannot be excluded (even in the Earth and solar environments). The observed low and high QPO frequencies are an intrinsic signature of the RTGW. The author elaborates the conditions for the density profile when the RTGW oscillations are stable. A comparison of the inferred QPO frequencies with QPO observations is presented. The author finds that hectohertz frequencies detected from NS binaries can be identified as the RTGW low branch frequencies. The author also predicts that an observer can see the double NS spin frequency during the NS long (super) burst events when the pressure gradients and buoyant forces are suppressed. The Coriolis force is the only force which acts in the rotational frame of reference and its presence causes perfect coherent pulsations with a frequency twice of the NS spin. The QPO observations of neutron binaries have established that the high QPO frequencies do not go beyond of the certain upper limit. The author explains this observational effect as a result of the density profile inversions. Also the author demonstrates that a particular problem of the gravity waves in the rotational frame of reference in the approximation of very small pressure gradients is reduced to the problem of the classical oscillator in the rotational frame of reference which was previously introduced and applied for the interpretation of kHZ QPO observation by Osherovich & Titarchuk.

Author

Neutron Stars; X Ray Binaries; Accretion Disks; Magnetohydrodynamics; Stellar Oscillations; Black Holes (Astronomy)

20030022798 California Inst. of Tech., Pasadena, CA, USA

A CO-12 J=6-5 Map of M82: The significance of warm molecular gas

Ward, John S.; Zmuidzinas, Jonas; Harris, Andrew I.; Isaak, Kate G.; [2003]; 34 pp.; In English; Original contains black and white illustrations

Report No.(s): Rept-2003-1; Copyright; Avail: Other Sources

We present a CO-12 J=6-5 map of the nuclear regions of the starburst galaxy M82 at a resolution of 14 inches taken at the Caltech Submillimeter Observatory (CSO). Hot spots were found on either side of the dynamical center. We compare our results with a high-resolution CO-12 J=2-1 interferometer map, and present a CO-12 J=6-5 / CO-12 J=2-1 line ratio map obtained using a novel deconvolution technique. This line ratio is highest at the two J=6-5 integrated intensity peaks, reaching 0.4 and 0.5 in the NE and SW peaks, respectively, and is typically 0.2 elsewhere in the nuclear region. We also present measurements of CO-12 J=4-3, CO-12 J=3-2, and CO-13 J=3-2, and an upper limit for CO-13 J=6-5. We analyze these observations in the context of a two-component large velocity gradient (LVG) excitation model. Likelihood density curves were calculated for each of the model parameters and a variety of related physical quantities for the NE and SW peaks based on the measured line intensities and their associated uncertainties. This approach reveals in an unbiased way how well various quantities can be constrained by the CO observations. We find that the beam-averaged CO-12 and CO-13 column densities, the isotopomer abundance ratio, and the area filling factors are among the best constrained quantities, while the cool component H2 density and pressure are less well constrained. The results of this analysis suggest that the warm gas is less dense than the cool gas, and that over half of the total molecular gas mass in these nuclear regions is warmer than 50 K.

Author

Astronomical Maps; Molecular Gases; Starburst Galaxies; Submillimeter Waves; Spectrum Analysis; Temperature Gradients

20030022799 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Intercluster Medium in Clusters

Mushotzky, R.; [2003]; 1 pp.; In English; Carnegie Observatories Centennial Symposium III, 27-31 Jan. 2003, Pasadena, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

With its large collecting area and adequate angular resolution XMM will enable large samples of well determined masses and baryon fractions for groups and clusters of galaxies. This will allow an estimate of the mass density of collapsed objects at the present epoch. Rich clusters can be detected and spatially resolved at r greater than 2 if they exist. There are numerous observing proposals to determine the cluster evolution with redshift which will have strong cosmological implications. The Fe abundance of rich clusters out to z-1 can be determined and thus strongly constrain the star formation history of the universe. Astro-E high spectral resolution will allow detailed determination of the elemental composition of galaxies groups and clusters and determine the origin of these elements. Astro-E data will also allow measurement of the velocity field in clusters for comparison with detailed numerical simulations.

Author

Gravitational Collapse; Density Measurement; Red Shift; Galactic Clusters; Stellar Evolution; Galactic Evolution; Stellar Composition

20030025362 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Complete Z-diagram of LMC X-2

White, Nicholas E., Technical Monitor; Smale, A. P.; Homan, J.; Kuulkers, E.; January 30, 2003; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We present results from four Rossi X-ray Timing Explorer (RXTE) observations of the bright low mass X-ray binary LMC X-2. During these observations, which span a year and include over 160 hrs of data, the source exhibits clear evolution through three branches on its hardness-intensity and color-color diagrams, consistent with the flaring, normal, and horizontal branches (FB, NB, HB) of a Z-source, and remarkably similar to Z-tracks derived for GX 17+2, Sco X-1 and GX 349+2. LMC X-2 was observed in the FB, NB, and HB for roughly 30\%, 40\%, and 30\% respectively of the total time covered. The source traces out the full extent of the Z in approximately 1 day, and the Z-track shows evidence for secular shifts on a timescale in excess of a few days. Although the count rate of LMC X-2 is low compared with the other known 2-sources due to its greater distance, the power density spectra selected by branch show very-low-frequency noise characteristics at least consistent with those from other Z-sources. We thus confirm the identification of LMC X-2 as a Z-source, the first identified outside our Galaxy.

Author

X Ray Binaries; X Ray Timing Explorer; Galaxies; Space Observations (From Earth); Mass; Neutron Stars

20030025398 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Strategies for Studying the Sources of Gamma Ray Bursts
Cline, T. L.; Norris, J. P.; Hurley, K. C.; February 20, 2003; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The study of gamma ray bursts (GRBs) has rapidly evolved in recent years with the discovery of their cosmological nature and with BATSE, BeppoSAX, HETE and the IPN enabling a wide variety of associated . afterglow measurements. Multiwavelength observations ranging through the radio, optical, soft and hard x-ray, and gamma-ray regimes have exploded the field of GRB interpretation. Also, the Amanda, Milagro and LIGO experiments can search for related neutrino, cosmic-ray photon, and gravitational radiation events, even with the delayed alerts, such as from the IPN. The infrared region, where the optical emissions from sources at the extreme distances may be shifted, will become important but is undersubscribed. The soon-to-be launched Swift mission will greatly broaden the GRB discipline, and a strategy for associated ground-based measurements is outlined. The need for the improved global distribution of all instruments, in particular, robotic infrared detectors, is cited.
Author
Gamma Ray Bursts; Afterglows; Laser Interferometry; Infrared Detectors; Gravitational Waves

20030025737 NASA Goddard Space Flight Center, Greenbelt, MD, USA
New Pulsars from Arecibo Drift Scan Searches
McLaughlin, M. A.; Lorimer, D. R.; Arzoumanian, Z.; Backer, D. C.; Cordes, J. M.; Fruchter, A.; Lommen, A. N.; Xilouris, K.; [2003]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

We report new pulsars discovered in drift-scan data taken by two collaborations (Berkeley/Cornell and STScI/NAIC) during the latter stages of the Arecibo upgrade period. The data were taken with the Penn State Pulsar Machine and are being processed on the COBRA cluster at Jodrell Bank. Processing is roughly 70\% complete and has resulted in the detection of 10 new and 31 known pulsars, in addition to a number of pulsar candidates. The 10 new pulsars include one pulsar with a spin-period of 55 ms and another with a spin period of 5.8 ms. At the completion of the processing, we expect to have discovered roughly 20 new pulsars. All new pulsars are being subjected to a program of followup observations at Arecibo to determine spin and astrometric parameters.
Author
Sky Surveys (Astronomy); Pulsars; Data Processing; Radio Astronomy

20030025742 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Two Types of Soft X-ray Spectra in Cataclysmic Variables
White, Nicholas E., Technical Monitor; Mukai, K.; Kinkhabwala, A.; Peterson, J. R.; Kahn, S. M.; Paerels, F.; [2002]; 13 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We present results of analyses of Chandra HETG soft X-ray spectra (Lambda = 1.5-25 A) of seven cataclysmic variables. We find that these spectra divide unambiguously into two distinct types. Spectra of the first type, consisting of EX Hya, V603 Aql, U Gem, and SS Cyg, are remarkably well fit by a simple cooling flow model, which assumes only steady-state isobaric radiative cooling. This model has only two free parameters, the maximum temperature, kT(sub max), which provides a rough measurement of the depth of the potential well, and the overall normalization, which provides a highly precise measurement of the total accretion rate. Spectra of the second type, consisting of V1223 Sgr, A Psc, and GK Per, are grossly inconsistent with a simple cooling flow model. They instead exhibit a hard continuum, and, in addition, show strong H-like and He-like ion emission but little Fe L-shell emission, which is consistent with expectations for line emission from a photoionized plasma. Using a simple photoionization model, we argue that the observed line emission for these sources can be driven entirely by the hard continuum. The physical significance of these two distinct types of X-ray spectra is also explored.
Author
X Ray Spectra; X Ray Stars; Cataclysmic Variables; Binary Stars; Ion Emission; Photoionization

20030031375 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The -145 km/s Absorption System of Eta Carinae
Vieira, G.; Gull, Theodore R.; Danks, A.; Johansson, S.; [2002]; 2 pp.; In English; AAS 201st Meeting, 5 Jan. 2003, Seattle, WA, USA; No Copyright; Avail: Other Sources; Abstract Only

With the STIS E230H mode (R approx. 118,000), we have identified about twenty absorption components in line of sight from Eta Carinae. Two components, one at -513 km/s and another at -145 km/s, are quite different in character from the others,

mostly at intermediate velocities. The -145 km/s component is significantly wider in fwhm, is seen in many more species, and the lower level can be above 20,000/cm, well above the 2000/cm noted in the -513 km/s component. In the spectral region from 2400 to 3160A, approximately 500 absorption lines have been identified. In this poster, we will present line identifications and atomic parameters of the measured lines, hopefully providing insight as to what levels are being excited and by what processes. Observations were accomplished through STScI under proposal 9242. Funding is through the STIS GTO resources.
Author
Absorption Spectra; Supermassive Stars; Stellar Spectra

20030031377 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae
Danks, Anthony; Gull, Theodore; Vieira, G.; Johansson, S.; [2002]; 2 pp.; In English; AAS 201st Meeting, 5 Jan. 2003, Seattle, WA, USA; No Copyright; Avail: Other Sources; Abstract Only

In the spectral region 2400-3160A of Eta Carinae, we have identified approximately 500 absorption lines each with up to twenty velocity components. The -512 kilometers per second component is truely unique as 1) the typical line width is less than 3 kilometers per second, 2) the identified lines are in Fe I, Fe II, V II and Ti II, and 3) the lines originate from lower levels up to 2000 cm-1 above the ground level. We have measured the velocity centers, full width at half maximum and equivalent widths for approximately 100 absorption lines. Initial results were very confusing as we found more variation in central velocities than would be expected from known STIS echelle wavelength standards. Upon further review, we found that the reporteded wavelengths in the NIST and Kurucz databases were not sufficiently accurate. S. Johansson searched FTS laboratory measurements performed at Lund for V II and Ti II and provided much improved wavelength measures. Likewise, we find more variation in column density than expected statistically from the accuracy of the equivalent widths for lines originating from the same energy level. We are reviewing the published gf values and our measurements to improve the measured column densities. Some spectroscopy of the ejecta has already been accomplished at two different epochs. Preliminary measures of equivalent widths indicate there may be some variation with time, but we await measurements planned for July 2003 during the upcoming spectroscopic minimum of Eta Carinae. These observations were accomplished through STScI and funding was from STIS GTO resources.
Author
Ejecta; Spectroscopy; Line Spectra; Absorption Spectra

90
ASTROPHYSICS

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

20030020869 California Univ., San Diego, CA, USA
State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay
Tomsick, John A.; [2002]; 4 pp.; In English
Contract(s)/Grant(s): NAG5-10886; No Copyright; Avail: CASI; A01, Hardcopy

The X-ray flux observed from X-ray transients changes by several orders of magnitude between quiescence and outburst, providing an excellent opportunity to learn about black hole candidates (BHCs) and accretion onto compact objects. Under an approved Rossi X-ray Timing Explorer (RXTE) observing proposal, I will observe BHC X-ray transients during outburst decay at flux levels between about 1 x 10(exp -10) and 4 x 10(exp -9) erg/sq cm/s. The observations to be made under this proposal take advantage of the full strength of the RXTE capabilities. Recently, for some BHC X-ray transients, decays were followed to low flux levels with RXTE and state transitions and low frequency quasi-periodic oscillations (QPOs) were observed. These phenomena are not well-understood at present, but they have the potential to provide information about accretion geometries, emission mechanisms, black holes and strong gravity. The goal of this work is to improve our understanding of state transitions and QPOs in accreting BHCs. Plans for multi-wavelength observations during state transitions are also underway to learn about connections between the accretion disk and radio jets.
Derived from text
X Ray Astronomy; Accretion Disks; Black Holes (Astronomy); Bursts

20030020874 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution
Dupree, Andrea K.; Mushotzky, Richard, Technical Monitor; March 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG5-9977
Report No.(s): SAO-16613321; No Copyright; Avail: CASI; A01, Hardcopy

This program addresses the evolution of stellar coronas by comparing a solar-like corona in the supergiant Beta Dra (G2 Ib-IIa) to the corona in the allegedly more evolved state of a hybrid star, alpha TrA (K2 II-III). Because the hybrid star has a massive wind, it appears likely that the corona will be cooler and less dense as the magnetic loop structures are no longer closed. By analogy with solar coronal holes, when the topology of the magnetic field is configured with open magnetic structures, both the coronal temperature and density are lower than in atmospheres dominated by closed loops. The hybrid stars assume a pivotal role in the definition of coronal evolution, atmospheric heating processes and mechanisms to drive winds of cool stars. We are attempting to determine if this model of coronal evolution is correct by using XMM-NEWTON RGS spectra for the 2 targets we were allocated through the Guest Observer program.
Author
Stellar Coronas; Stellar Evolution; Cool Stars; Stellar Temperature; Astronomical Models; Supergiant Stars; Stellar Spectra

20030020878 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources
Oliversen, Ronald J., Technical Monitor; Elvis, Martin; March 2003; 2 pp.; In English
Contract(s)/Grant(s): NAG5-9206; No Copyright; Avail: CASI; A01, Hardcopy

The primary source catalog of 'blanks' (bright ROSAT sources with no optical counterparts) has been published in the Astrophysical Journal. The first follow-up paper has also been published. This paper used a combination of ROSAT, Chandra and ground based data to convincingly identify one of the blanks as a Ultra-luminous X-ray source (ULX) in a spiral galaxy. A paper detailing optical and near-IR imaging observations of the remaining sources is underway.
Author
Rosat Mission; Quasars; X Ray Sources; X Ray Astronomy; X Rays

20030022664 NASA Goddard Space Flight Center, Greenbelt, MD, USA
What can we learn about cosmic structure from gravitational waves?
Centrella, Joan M.; January 02, 2003; 10 pp.; In English; The Emergence of Cosmic Structure Workshop, [2003]; No Copyright; Avail: CASI; A02, Hardcopy

Observations of low frequency gravitational waves by the space-based LISA mission will open a new observational window on the early universe and the emergence of structure. LISA will observe the dynamical coalescence of massive black hole binaries at high redshifts, giving an unprecedented look at the merger history of galaxies and the reionization epoch. LISA will also observe gravitational waves from the collapse of supermassive stars to form black holes, and will map the spacetime in the central regions of galaxy cusps at high precision.
Author
Gravitational Waves; Black Holes (Astronomy); Cosmology; LISA (Observatory); Radio Observation; Supermassive Stars

20030022669 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts
Cane, H. V.; Erickson, W. C.; [2003]; ISSN 0148-0227; 17 pp.; In English
Contract(s)/Grant(s): NSF ATM-98-19798; NSF ATM-02-07221; Copyright; Avail: CASI; A03, Hardcopy

Solar energetic particle (SEP) events are well-associated with solar flares. It is observed that the delay between the time of the flare and the first-arriving particles at a spacecraft increases with increasing difference between the flare longitude and the footpoint of the field line on which the spacecraft is located. This difference we call the 'connection angle' and can be as large as approximately 120 deg. Recently it has been found that all SEP events are preceded by type III radio bursts. These bursts are plasma emission caused by the propagation of 2-50 keV flare electrons through the solar corona and into the solar wind. The drift of these type III radio bursts to lower and lower frequencies enables the propagation of the flare electrons to be traced from the Sun to about 1 AU. We have made an extensive analysis of the type III bursts associated with greater than 20 MeV proton events and find that, in most cases, the radio emission extends to the local plasma frequency when the energetic particles arrive within a few hours of the flare. We conclude that this emission at the lowest possible frequency is generated

close to the spacecraft. We then use the time from when the burst started at the Sun to when it reached the local plasma frequency to infer the time it took the radio producing electrons to travel to the spacecraft. We find that these delay times are organized by the connection angle and correlate with the proton delay times. We also find that the differences between the radio delays at Wind and Ulysses are matched by differences in the relative arrival times of the energetic particles at the two spacecraft. The consistent timing between the relative arrival times of energetic electrons and protons and the start of the lowest frequency radio emissions suggests that the first arriving particles of both species are accelerated as part of the flare process and that they propagate to the spacecraft along trajectories similar to those of the lower energy flare electrons. To be detected by observers at locations distant from the nominal field lines originating in the flaring regions the particles must undergo lateral transport. The continuity of the radio bursts suggests that the cross-field transport may occur in the interplanetary medium.
Author
Energetic Particles; Heliosphere; Low Frequencies; Radio Emission; Solar Protons; Propagation; Radio Observation; Type 3 Bursts

20030022700 NASA Goddard Space Flight Center, Greenbelt, MD, USA
X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming
Strohmayer, Tod E.; Mushotzky, Richard F.; [2003]; 16 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

We report the discovery with the European Photon Imaging Camera (EPIC) CCD cameras onboard XMM-Newton of a 54 mHz quasiperiodic oscillation (QPO) in the greater than 2 keV X-ray flux from the ultra-luminous X-ray source (ULX) X41.4+60 in the starburst galaxy M82. This is the first detection of a QPO in the X-ray flux from an extra-Galactic ULX, and confirms that the source is a compact object. The QPO is detected in the combined PN and MOS data at the approx. 6sigma level, and separately at lower significances in both the PN and MOS instruments. It had a centroid frequency of 54.3 +/- 0.9 mHz, a coherence Q is identical with nu(sub 0)/Delta nu(sub fwhm) is approx. 5, and an amplitude (rms) in the 2 - 10 keV band of 8.5\%. Below about 0.2 Hz the power spectrum can be described by a power-law with index approx. 1, and integrated amplitude (rms) of 13.5\%. The X-ray spectrum requires a curving continuum, with a disk-blackbody (diskbb) at T = 3.1 keV providing an acceptable, but not unique, fit. A broad Fe line centered at 6.55 keV is required in all fits, but the equivalent width (EW) of the line is sensitive to the choice of continuum model. There is no evidence of a reflection component. The implied bolometric luminosity is approx. 4 - 5 x 10(exp 40) ergs/s. Data from several archival Rossi X-ray Timing Explorer (RXTE) pointings at M82 also show evidence for QPOs in the 50 - 100 mHz frequency range. Several Galactic black hole candidates (BHCs), including GRS 1915+105, GRO J1655-40, and XTE 1550-564, show QPOs in the same frequency range as the 50 - 100 mHz QPOs in X41.4+60, which at first glance suggests a possible connection with such objects. However, strong, narrow QPOs provide solid evidence for disk emission, and thus present enormous theoretical difficulties for models which rely on either geometrically or relativistically beamed emission to account for the high X-ray luminosities. We discuss the implications of our findings for models of the ULX sources.
Author
Black Holes (Astronomy); Starburst Galaxies; Oscillations; X Ray Sources

20030022711 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Atomic Data for the K-Vacancy States of Fe XXIV
Bautista, M. A.; Mendoza, C.; Kallman, T. R.; Palmeri, P.; [2002]; 18 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

As part of a project to compute improved atomic data for the spectral modeling of iron K lines, we report extensive calculations and comparisons of atomic data for K-vacancy states in Fe XXIV. The data sets include: (i) energy levels, line wavelengths, radiative and Auger rates; (ii) inner-shell electron impact excitation rates and (iii) fine structure inner-shell photoionization cross sections. The calculations of energy levels and radiative and Auger rates have involved a detailed study of orbital representations, core relaxation, configuration interaction, relativistic corrections, cancellation effects and semi-empirical corrections. It is shown that a formal treatment of the Breit interaction is essential to render the important magnetic correlations that take part in the decay pathways of this ion. As a result, the accuracy of the present A-values is firmly ranked at better than 10\% while that of the Auger rates at only 15\%. The calculations of collisional excitation and photoionization cross sections take into account the effects of radiation and spectator Auger dampings. In the former, these effects cause significant attenuation of resonances leading to a good agreement with a simpler method where resonances are excluded. In the latter, resonances converging to the K threshold display symmetric profiles of constant width that causes edge smearing.
Author
Atomic Excitations; Iron; K Lines; Astrophysics; Electron States; Auger Spectroscopy

20030022713 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities

Christodoulou, Dimitris M.; Contopoulos, John; Kazanas, Demosthenes; December 16, 2002; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

We obtain the general forms of the axisymmetric stability criteria in a magnetized compressible Couette flow using an energy variational principle, the so-called interchange or Chandrasekhar s met hod, which we applied successfully in the incompressible case. This formulation accounts for the simultaneous presence of gravity, rotation, a toroidal magnetic field, a weak axial magnetic field, entropy gradients, and density gradients in the initial equilibrium state. The power of the method lies in its simplicity which allows us to derive extremely compact and physically clear expressions for the relevant stability criteria despite the inclusion of so many physical effects. In the implementation of the method, all the applicable conservation laws are explicitly taken into account during the variations of a quantity with dimensions of energy which we call the free energy function. As in the incompressible case, the presence of an axial field invalidates the conservation laws of angular momentum and azimuthal magnetic flux and introduces instead isorotation and axial current conservation along field lines. Our results are therefore markedly different depending on whether an axial magnetic field is present, and generalize in two simple expressions all previously known, partial stability criteria for the appearance of magnetorotational instability. Furthermore, the coupling between magnetic tension and buoyancy and its influence to the dynamics of nonhomoentropic magnetized flows becomes quite clear from our results. In the limits of plane-parallel atmospheres and homoentropic flows, our formulation easily recovers the stability criteria for suppression of convective and Parker instabilities, as well as some related special cases studied over 40 years ago by Newcomb and Tserkovnikov via laborious variational techniques.

Author

Couette Flow; Conservation Laws; Magnetohydrodynamics; Magnetic Field Configurations; Accretion Disks; Compressible Flow

20030022718 Washington Univ., Vancouver, WA, USA

Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores

Brook, Edward; [2002]; 7 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-9345; No Copyright; Avail: CASI; A02, Hardcopy

This grant funded measurements of extraterrestrial He-3 in particles extracted from polar ice samples. The overall objective was to develop measurements of He-3 as tracers of the flux of interplanetary dust particles (IDP's) to the earth. To our knowledge these are the first such measurements, apart from our earlier work. The project also funded an EPO activity - a climate and global change workshop for high school science teachers.

Derived from text

Helium Isotopes; Interplanetary Dust; Polar Regions; Ice

20030022761 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Origin of Soft X-rays in DQ Herculis

White, Nicholas E., Technical Monitor; Mukai, K.; Still, M.; Ringwald, F. A.; [2002]; 18 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

DQ Herculis (Nova Herculis 1934) is a deeply eclipsing cataclysmic variable containing a magnetic white dwarf primary. The accretion disk is thought to block our line of sight to the white dwarf at all orbital phases due to its extreme inclination angle. Nevertheless, soft X-rays were detected from DQ Her with ROSAT PSPC. To probe the origin of these soft X-rays, we have performed Chandra ACIS observations. We confirm that DQ Her is an X-ray source. The bulk of the X-rays are from a point-like source and exhibit a shallow partial eclipse. We interpret this as due to scattering of the unseen central X-ray source, probably in an accretion disk wind. At the same time, we detect weak extended X-ray features around DQ Her, which we interpret as an X-ray emitting knot in the nova shell.

Author

Cataclysmic Variables; X Ray Sources; Hercules Nova; White Dwarf Stars; X Ray Astrophysics Facility

20030022787 NASA Goddard Space Flight Center, Greenbelt, MD, USA

An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet

Angelini, Lorella; White, Nicholas E.; [2003]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

We report an XMM-Newton observation of the Low mass X-ray Binary (LMXB) and black hole candidate 4U1755-33.

This source had been a bright persistent source for at least 25 yrs, but in 1995 entered an extended quiescent phase. 4U1755-33 was not detected with an upper limit to the 2-10 keV luminosity of 5 x 10(exp 31) d(sup 2) (sub 4kpc) ergs per second (where d(sub 4kpc) is the distance in units of 4 kpc) - consistent with the luminosity of other black hole candidates in a quiescent state. An unexpected result is the discovery of a narrow 7 arc min long X-ray jet centered on the position of 4Ul755-33. The spectrum of the jet is similar to that of jets observed from other galactic and extragalactic sources, and may have been ejected from 4Ul755-33 when it was bright. Jets are a feature of accreting black holes, and the detection of a fossil jet provides additional evidence supporting the black hole candidacy of 4U1755-33. The spectral properties of three bright serendipitous sources in the field are reported and it is suggested these are background active galactic nuclei sources.
Author
Black Holes (Astronomy); X Ray Binaries; Xmm-Newton Telescope; Observation; X Ray Astronomy

20030022790 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Chandra Observation of the X-ray Source Population of NGC 6946
Holt, S. S.; Schlegel, E. M.; Hwang, U.; Petre, R.; [2003]; 20 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS8-38073
Report No.(s): astro-ph/0301319-Vol-1; Copyright; Avail: CASI; A03, Hardcopy

We present the results of a study of discrete X-ray sources in NGC 6946 using a deep Chandra ACIS observation. Based on the slope of the log N-log S distribution and the general correlation of sources with the spiral arms, we infer that the overall discrete source sample in NGC 6946 is dominated by high mass X-ray binaries, in contrast to the source distributions in M31 and the Milky Way. This is consistent with the higher star formation rate in NGC 6946 than in those galaxies. We find that the strong X-ray sources in the region of the galactic center do not correlate in detail with images of the region in the near-IR, although one of them may be coincident with the galactic center. The non-central ultra-luminous X-ray source in NGC 6946, previously identified with a supernova remnant, has an X-ray spectrum and luminosity that is inconsistent with either a traditional pulsar wind nebula or a blast wave remnant.
Author
X Ray Binaries; X Ray Sources; Milky Way Galaxy; X Ray Astrophysics Facility; Supernova Remnants

20030022794 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV
Palmeri, P.; Mendoza, C.; Kallman, T. R.; Bautista, M. A.; [2002]; 33 pp.; In English
Contract(s)/Grant(s): FONACIT Proj. S1-20022000912; Copyright; Avail: CASI; A03, Hardcopy

A complete set of level energies, wavelengths, A-values, and total and partial Auger rates have been computed for transitions involving the K-vacancy states within the n = 2 complex of Fe XVIII-Fe XXV. Three different standard numerical packages are used for this purpose, namely AUTOSTRUCTURE, the Breit-Pauli R-matrix suite (BPRM) and HFR, which allow reliable estimates of the physical effects involved and of the accuracy of the resulting data sets. It is found that the Breit interaction must be always taken into account as the contributions to the small A-values and partial Auger rates does not decrease with electron occupancy. Semi-empirical adjustments can also lead to large differences in both the radiative and Auger decay data of strongly mixed levels. Several experimental energy levels and wavelengths are questioned, and significant discrepancies are found with previously computed decay rates that are attributed to numerical problems. The statistical accuracy of the present level energies and wavelengths is ranked at plus or minus 3 eV and plus or minus 2 mAngstroms, respectively, whereas that for A-values and partial Auger rates greater than 10(exp 13) per second is estimated at better than 20\%.
Author
Auger Spectroscopy; K Lines; Electron States; Iron; Electron Transitions; X Ray Spectroscopy; Auger Effect

20030022795 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors
Band, David L.; January 08, 2003; 24 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Gamma-ray burst detectors are sensitive at different energies, complicating the comparison of the burst populations that they detect. The instrument teams often report their detector sensitivities in their instruments' energy band. I propose that sensitivities be reported its the threshold peak photon flux FT over the 1-1000 keV energy band for a specific spectral shape. The primary spectral parameter is E(sub p), the energy of the maximum E(sup 2)N(sub E) proportional to upsilon f(sub upsilon). Thus F(sub T) vs. E(sub p). E(sub p) is a useful description of a detector's sensitivity. I find that Swift will be

marginally more sensitive than BATSE for E(sub p) greater than 100 keV, but significantly more sensitive for E(sub p) less than 100 keV. Because of its small field-of-view and low energy sensitivity, the FREGATE on HETE-2 is surprisingly sensitive. Both the WFC on BeppoSAX and the WXM on HETE-2 are/were sensitive for low E(sub p). As expected, the GBM on GLAST will be less sensitive than BATSE, while EXIST will be significantly more sensitive than Swift. The BeppoSAX GRBM was less sensitive that the WFC, particularly at low E(sub p).
Author
Gamma Ray Bursts; Sensitivity; Detectors; Astrophysics; Spaceborne Telescopes

20030022796 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries
Titarchuk, Lev; White, Nicholas E., Technical Monitor; Astrophysical Journal; October 10, 2002; Volume 578, pp. L71-L74; In English; Copyright; Avail: Other Sources

Using a large quantity of Rossi X-Ray Timing Explorer data presented in the literature, I offer a detailed investigation into the accuracy of the quasi-periodic oscillation (QPO) frequency determination. The QPO phenomenon seen in X-ray binaries is possibly a result of the resonance of the intrinsic (eigen) oscillations and harmonic driving forces of the system. I show that the resonances, in the presence of the damping of oscillations, occur at frequencies that are systematically and randomly shifted with respect to the eigenfrequencies of the system. The shift value strongly depends on the damping rate that is measured by the half-width of the QPO feature. Taking into account this effect, I analyze the QPO data for four Z sources, Scorpius X-I, GX 340+0, GX 5-1, and GX 17+2, and two atoll sources, 4U 1728-34 and 4U 0614+09. The transition-layer model (TLM) predicts the existence of the invariant quantity delta, an inclination angle of the magnetospheric axis with respect to the normal to the disk. I calculate delta and the error bars of delta using the resonance shift, and I find that the inferred delta-values are consistent with constants for these four Z sources, in which horizontal-branch oscillation and kilohertz frequencies have been detected and correctly identified. It is shown that the inferred delta are in the range between 5.5 deg and 6.5 deg. I conclude that the TLM seems to be compatible with the data.
Author
Resonance; Oscillations; Neutron Stars; X Ray Binaries; Accretion Disks

20030022797 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components
White, Nicholas E., Technical Monitor; Boyd, Patricia T.; Smale, Alan P.; [2002]; 19 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

LMC X-3 and Cyg X-2 show large amplitude X-ray fluctuations that have been attributed to a warped accretion disk. Cyg X-3 displays high amplitude, apparently non-periodic oscillations. We reanalyze these systems using RXTE ASM data and time-frequency decomposition techniques. We find that the long-term variations in Cyg X-2 can be completely characterized by excursions whose durations are integer multiples of the orbital period, including one essentially identical to the reported 'period' of 78 days. Cyg X-3 can be characterized in terms of integer multiples of a 71-day fundamental period unrelated to the 4.8 day orbital period, but suggestively close to the approximately equal to greater than 60 day reported precession period of the relativistic jet inferred from recent radio observations. The long-term excursions of LMC X-3 are related to each other by rational fractions, suggesting the characteristic time scale is 10.594 days, shorter than any observed excursion to date. We explore the phase space evolution of the light curves using a natural embedding and find that all three systems possess two rotation centers that organize the phase space trajectories, one of low luminosity and the other of high luminosity. The implications of this repeatable behavior on generic models of accretion disk dynamics and mass transfer variability are explored.
Author
X Ray Binaries; Astrophysics; Light Curve; Random Processes; X Ray Astronomy; Variations

20030023598 Liege Univ., Belgium
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population
Naze, Y.; Hartwell, J. M.; Stevens, I. R.; Manfroid, J.; Marchenko, S.; Corcoran, M. F.; Moffat, A. F. J.; Skalkowski, G.; [2003]; 28 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): SSTC-P4/05; SSTC-P5/36; Copyright; Avail: CASI; A03, Hardcopy

We present results from a Chandra observation of the NGC 346 cluster, which is the ionizing source of N66, the most luminous HII region and the largest star formation region in the SMC. In the first part of this investigation, we have analysed

the X-ray properties of the cluster itself and the remarkable star HD 5980. But the field contains additional objects of interest. In total, 79 X-ray point sources were detected in the Chandra observation: this is more than five times the number of sources detected by previous X-ray surveys. We investigate here their characteristics in detail. The sources possess rather high hardness ratios, and their cumulative luminosity function is steeper than that for the rest of the SMC at higher .luminosities. Their absorption columns suggest that most of the sources belong to NGC346. Using new UBV RI imaging with the ESO 2.2m telescope, we also discovered possible counterparts for 36 of these X-ray sources and estimated a B spectral type for a large number of these counterparts. This tends to suggest that most of the X-ray sources in the field are in fact X-ray binaries. Finally, some objects show X-ray and/or optical variability, with a need for further monitoring.
Author
H Ii Regions; X Ray Astrophysics Facility; Star Clusters; Magellanic Clouds; Star Formation

20030023714 NASA Goddard Space Flight Center, Greenbelt, MD, USA
New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20
Parke, William; Ibrahim, Alaa I.; Swank, Jean H.; [2002]; 5 pp.; In English
Contract(s)/Grant(s): NAG5-11951; Copyright; Avail: CASI; A02, Hardcopy

A great deal of evidence has recently been gathered in favor of the picture that Soft Gamma Repeaters and Anomalous X-Ray Pulsars are powered by ultra-strong magnetic fields (B greater than 10(exp 14) G; i.e. magnetars). Nevertheless, present determination of the magnetic field in such magnetar candidates has been indirect and model dependent. A key prediction concerning magnetars is the detection of ion cyclotron resonance features, which would offer a decisive diagnostic of the field strength. Here we present the detection of a 5 keV absorption feature in a variety of bursts from the Soft Gamma Repeater SGR 1806-20, confirming our initial discovery and establishing the presence of the feature in the source's burst spectra. The line feature is well explained as proton cyclotron resonance in an ultra-strong magnetic field, offering a direct measurement of SGR 1806-20's magnetic field (B approx. 10(exp 15) G) and a clear evidence of a magnetar. Together with the source's spin-down rate, the feature also provides the first measurement of the gravitational redshift, mass and radius of a magnetar.
Author
Proton Resonance; Cyclotron Resonance; Magnetars; Magnetic Fields

20030025228 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events?
Richardson, I. G.; Lawrence, G. R.; Haggerty, D. K.; Kucera, T.; Szabo, A.; [2002]; ISSN 0094-8276; 5 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Recent studies have proposed that the presence or absence of an interaction with a preceding coronal mass ejection (CME) or other coronal structure within approximately 50R(sub s), of the Sun discriminates large, fast CMEs associated with major solar energetic particle (SEP) events from those that are not. We conclude that there is no compelling evidence that, if such interactions take place, they play an important role in SEP acceleration. Reasons include: The reported statistical results are consistent with a chance association between interacting CMEs and SEP events; Energetic SEPs are detected at Earth typically before or around the time when the primary CME enters the LASCO C2 field of view - interactions higher in the corona cannot play a role in acceleration of these particles; For approximately 60\% of major SEP events in 1997-2001, the preceding CME fades into the background corona or is relatively narrow (less than 40 deg), suggesting any interaction will be weak; Radio signatures attributed to CME interaction occur after SEP acceleration has commenced.
Author
Solar Flares; Coronal Mass Ejection; Solar Corpuscular Radiation; Energetic Particles; Infrared Signatures; Radio Astronomy; Solar Corona

20030025241 Johns Hopkins Univ., Baltimore, MD, USA
A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies
Lubin, Lori M.; [2002]; 1 pp.; In English
Contract(s)/Grant(s): NAG5-10511; No Copyright; Avail: CASI; A01, Hardcopy

We are obtaining detailed X-ray spectral and structural data for two distant, optically-selected clusters of galaxies which are known X-ray emitters, CL1324+3011 at z=0.76 and CL1604+4304 at z=0.90. These observations will allow us to place accurate constraints on the temperature, surface-brightness profile, and mass fraction of the intracluster medium in rich, optically-selected clusters at very high redshift. The two target clusters are the most well-studied systems at z greater than 0.7 in the optical and infrared regimes; therefore, with the addition of the XMM data, we plan to study the specifics of the

relationship between the X-ray and optical properties and their implications for galaxy and cluster evolution.
Derived from text
Emitters; Galactic Clusters; Red Shift; X Ray Spectra

20030025263 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE
Sturner, S. J.; Keohane, J. W.; Reimer, O.; [2002]; 7 pp.; In English; COSPAR 2002, 10-19 Oct. 2002, Houston, TX, USA; Copyright; Avail: CASI; A02, Hardcopy

In this paper we present analysis of X-ray spectra from the supernova remnant IC443 obtained using the PCA on RXTE. The spectra in the 3 - 20 keV band are well fit by a two-component model consisting of thermal and nonthermal components. We compare these results with recent results of other X-ray missions and discuss the need for a cut-off in the nonthermal spectrum. Recent Chandra and XMM-Newton observations suggest that much of the nonthermal emission from IC443 can be attributed to a pulsar wind nebula. We present the results of our search for periodic emission in the RXTE PCA data. We then discuss the origin o f the nonthermal component and its possible association with the unidentified EGRET source.
Author
Nonthermal Radiation; Supernova Remnants; Space Observations (From Earth); X Ray Timing Explorer; Mathematical Models

20030025357 NASA Goddard Space Flight Center, Greenbelt, MD, USA
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814
Mukai, K.; Hellier, C.; Madejski, G.; Patterson, J.; Skillman, D. R.; [2003]; 41 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

V1432 Aquilae (=RX J1940.2-1025) is the X-ray bright, eclipsing magnetic cataclysmic variable approximately 37 (sup) away from the Seyfert galaxy, NGC 6814. Due to a 0.3\% difference between the orbital (12116.3 s) and the spin (12150 s) periods: the accretion geometry changes over the approximately 50 day beat period. Here we report the results of an RXTE campaign to observe the eclipse 25 times, as well as of archival observations with ASCA and BeppoSAX. Having confirmed that the eclipse is indeed caused by the secondary, we use the eclipse timings and profiles to map the accretion geometry as a function of the beat phase. We find that the accretion region is compact, and that it moves relative to the center of white dwarf on the beat period. The amplitude of this movement suggest a low-mass white dwarf, in contrast to the high mass previously estimated from its X-ray spectrum. The size of the X-ray emission region appears to be larger than in other eclipsing magnetic CVs. We also report on the RXTE data as well as the long-term behavior of NGC 6814, indicating flux variability by a factor of at least 10 on time scales of years.
Author
Cataclysmic Variables; Seyfert Galaxies; Variable Stars; Magnetic Stars; Astrophysics

20030025397 Utah Univ., Salt Lake City, UT, USA
Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors
Sokolsky, P.; Krizmanic, J.; [2003]; 23 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; A03, Hardcopy

Space-based ultra-high-energy cosmic ray detectors observe fluorescence light from extensive air showers produced by these particles in the troposphere. Clouds can scatter and absorb this light and produce systematic errors in energy determination and spectrum normalization. We study the possibility of using IR remote sensing data from MODIS and GOES satellites to delimit clear areas of the atmosphere. The efficiency for detecting ultra-high-energy cosmic rays whose showers do not intersect clouds is determined for real, night-time cloud scenes. We use the MODIS SST cloud mask product to define clear pixels for cloud scenes along the equator and use the OWL Monte Carlo to generate showers in the cloud scenes. We find the efficiency for cloud-free showers with closest approach of three pixels to a cloudy pixel is 6.5\% exclusive of other factors. We conclude that defining a totally cloud-free aperture reduces the sensitivity of space-based fluorescence detectors to unacceptably small levels.
Author
Apertures; Remote Sensing; Detectors; Airborne Equipment; Fluorescence; Cosmic Ray Showers; Clouds (Meteorology)

20030025443 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission
White, Nicholas E., Technical Monitor; Muslimov, Alex G.; Harding, Alice K.; [2003]; 24 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We revise the physics of primary electron acceleration in the 'slot gap' (SG) above the pulsar polar caps (PCs), a regime originally proposed by Arons and Scharlemann (1979) in their electrodynamic model of pulsar PCs. We employ the standard definition of the SG as a pair-free space between the last open field lines and the boundary of the pair plasma column which is expected to develop above the bulk of the PC. The rationale for our revision is that the proper treatment of primary acceleration within the pulsar SGs should take into account the effect of the narrow geometry of the gap on the electrodynamics within the gap and also to include the effect of inertial frame dragging on the particle acceleration. We show that the accelerating electric field within the gap, being significantly boosted by the effect of frame dragging, becomes reduced because of the gap geometry by a factor proportional to the square of the SG width. The combination of the effects of frame dragging and geometrical screening in the gap region naturally gives rise to a regime of extended acceleration, that is not limited to favorably curved field lines as in earlier models, and the possibility of multiple-pair production by curvature photons at very high altitudes, up to several stellar radii. We present our estimates of the characteristic SG thickness across the PC, energetics of primaries accelerated within the gap, high-energy bolometric luminosities emitted from the high altitudes in the gaps, and maximum heating luminosities produced by positrons returning from the elevated pair fronts. The estimated theoretical high-energy luminosities are in good agreement with the corresponding empirical relationships for gamma-ray pulsars. We illustrate the results of our modeling of the pair cascades and gamma-ray emission from the high altitudes in the SG for the Crab pulsar. The combination of the frame-dragging field and high-altitude SG emission enables both acceleration at the smaller inclination angles and a larger emission beam, both necessary to produce widely-spaced double-peaked profiles.
Author
Particle Acceleration; Field Emission; Electrodynamics; Electric Fields; Pulsars; Gamma Rays

20030025446 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1
Hollis, J. M.; Pedelty, J. A.; Snyder, L. E.; Jewell, P. R.; Lovas, F. J.; Palmer, Patrick; Liu, S.-Y.; [2002]; 26 pp.; In English Contract(s)/Grant(s): NAG5-8708; NSF AST-99-81363; NSF AST-99-81546; RTOP 344-02-03-01; RTOP 188-02-02-01; Copyright; Avail: CASI; A03, Hardcopy

We have conducted a deep Q-band (lambda-7 mm) search with the Very Large Array (VLA) toward OMC-1 for the lowest energy conformation (conformer I) of glycine (NH2CH2COOH) in four rotational transitions: the 6(sub 15)- 5(sub 14), 6(sub 24)-5(sub 23), 7(sub 17- 6(sub 16), and 7(sub 07)-6(sub 06). Our VLA observations sample the smallest-scale structures to date in the search for glycine toward OMC-1. No glycine emission features were detected. Thus if glycine exists in OMC-1, either it is below our detection limit, or it is more spatially extended than other large molecules in this source, or it is primarily in its high energy form (conformer II). Our VLA glycine fractional abundance limits in OMC-1 are comparable to those determined from previous IRAM 30m measurements -- somewhat better or worse depending on the specific source model -- and the entire approximately 1 foot primary beam of the VLA was searched while sensitive to an areal spatial scale approximately 150 times smaller than the 24 inch beam of the IRAM single-element telescope. In the course of this work, we detected and imaged the 4(sub 14)-3(sub 13) A and E transitions of methyl formate (HCOOCH3) and also the 2(sub 02) - 1(sub 01) transition of formic acid (HCOOH). Since formic acid is a possible precursor to glycine, our glycine limits and formic acid results provide a constraint on this potential formation chemistry route for glycine in OMC-1.
Author
Very Large Array (Vla); Radio Astronomy; Glycine; Interstellar Chemistry; Molecules; Interstellar Matter; Chemical Reactions; Cosmochemistry

20030025688 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum
Reames, D. V.; McDonald, F. B.; [2003]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We report the first observation near Earth of the time behavior of anomalous cosmic-ray N, O, and Ne ions through the period surrounding the maximum of the solar cycle. These observations were made by the Wind spacecraft during the 1995-2002 period spanning times from solar minimum through solar maximum. Comparison of anomalous and galactic cosmic rays provides a powerful tool for the study of the physics of solar modulation throughout the solar cycle.
Author
Solar Activity Effects; Galactic Cosmic Rays; Solar Wind; Solar Cycles

20030025744 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Resource Letter GrW-1: Gravitational Waves
White, Nicholas E., Technical Monitor; Centrella, Joan M.; January 2003; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The phenomenon of gravitational radiation was one of the first predictions of Einstein's general theory of relativity. Progress in understanding this radiation theoretically was slow at first, owing to the difficulty of the nonlinear field equations and the subtleties of their physical effects. The experimental side of this subject also has taken a long time to develop, with efforts at detection severely challenged by the extreme weakness of the waves impinging on the Earth. However, as the 21st century begins, observations of the gravitational waves from astrophysical sources such as black holes, neutron stars, and stellar collapse are expected to open a new window on the universe. Vigorous experimental programs centered on ground-based detectors are being carried out worldwide, and a space-based detector is in the planning stages. On the theoretical side, much effort is being expended to produce robust models of the astrophysical sources and accurate calculations of the waveforms they produce. In this Resource Letter, a set of basic references will be presented first, to provide a general introduction to and overview of the literature in this field. The focus then will shift to highlighting key resources in more specialized areas at the forefront of current research.
Derived from text
Astrophysics; Gravitational Waves; Periodicals; Relativity

20030031330 Colorado Univ., Boulder, CO, USA
XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA
Skinner, Stephen L.; Astrophysical Journal; [2003]; Volume 572, Part 1, pp. 477; In English
Contract(s)/Grant(s): NAG5-10362; No Copyright; Avail: CASI; A01, Hardcopy

In this research program, we obtained and analyzed X-ray observations of the Wolf-Rayet (WR) star WR 110 (HD 165688) using the XMM-Newton space-based observatory. Radio observations were also obtained using the Very Large Array (VLA) radio telescope located in New Mexico and operated by the Natl. Radio Astronomy Observatory (NRAO). This star was targeted for observations primarily because it is believed to be a single WR star without a companion. Single WR stars are thought to emit X-rays from cool plasma in shocks distributed throughout their powerful stellar winds. However, there has been little observational work done to test this idea since single WR stars are relatively weak X-ray sources and have been difficult to detect with previous generation telescopes. The launch of XMM-Newton provides a new telescope that is much more sensitive than its predecessors, allowing single WR stars to be studied in detail for the first time. X-ray emission was clearly detected from WR 110. Analysis of its spectrum yields a surprising result. Its X-ray emitting plasma is distributed over a range of temperatures and is dominated by relatively cool plasma with a characteristic temperature T is approximately 6 million K. Such plasma can be explained by existing theoretical wind shock models. However, the spectrum also shows hotter plasma whose temperature is uncertain but is thought to be in excess of T approximately 30 million K. The origin of this hotter plasma is yet unknown, but possible mechanisms are identified
Author
Wolf-Rayet Stars; Plasmas (Physics); Radio Astronomy; Stellar Structure; X Ray Astronomy; X Ray Spectra; Stellar Winds

91
LUNAR AND PLANETARY SCIENCE AND EXPLORATION

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

20030020925 NASA Glenn Research Center, Cleveland, OH, USA
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars
Udrea, Bogdan; Delory, Greg; Landis, Geoffrey; Duvet, Ludovic; Choudhuri, Ahsan; Prina, Mauro; Moreels, Pierre; Bedard, Donald; Furano, Gianluca; [2002]; 9 pp.; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA
Report No.(s): IAF-02-Q.3.2.03; E-13687; Copyright; Avail: CASI; A02, Hardcopy

WOBBLE ('Water Observations from a Balloon Borne Light Explorer') is a mission concept study for a small robotic probe to explore Mars and to accomplish a scientific mission compatible with the goals of the NASA Code S enterprise. The detection of past or present water is a crucial goal for Mars exploration, representing a cross-cutting science theme relevant to past or extant life, climate history, sample return missions and eventual human exploration. The WOBBLE mission concept was developed to study evidence of water using in-situ detection methods. The features on Mars most suited to this investigation are the gullies identified by Malin and Edgett as evidence for recent, near-surface runoff of liquid water. These features are typically located on the inside face of crater rims, where the local slope angle is at or near the angle of repose. This makes the terrain difficult or impossible to access with conventional wheeled rover technology. Combined with the small

size of the gullies in relation to a standard landing error ellipse, scientific investigation of these features requires a new approach to surface mobility. WOBBLE uses a low-altitude balloon-borne platform to traverse the surface from the landing site, to the investigation site, and then rise up the slope to investigate the regions of interest at close range. Of the mobility technologies available for near-term Mars exploration, only a balloon platform is capable of a well targeted, detailed sampling of the gully regions over periods of days or more. The science approach embodied in WOBBLE is two-pronged, designed to investigate both the historical evidence of liquid water utilizing high-resolution geomorphology and the characterization of mineral deposits, and present subsurface liquid water using radar sounding techniques. The WOBBLE balloon is a high-pressure hydrogen gas design, 24 meters in diameter and lifting a total payload of 130 kg, including a high-resolution camera/IR imager, Raman spectrometer, and a ground penetrating radar (GPR) sounder. The stowed balloon and payload are designed to fit within the current airbag delivery system being built for the Mars Exploration Rovers. Characterization of local meteorological conditions and wind is made over the initial sols following landing and before balloon inflation. Following balloon inflation and launch, a controlled, targeted approach toward the identified regions of interest is made in a series of several low-altitude 'hops,' with the balloon tethered to the ground between the hop intervals. A 'snake' system is used to control the altitude to a few tens of meters above the local ground level. Enroute to the target gully, GPR soundings and Raman spectroscopy measurements study past or present water, while continued camera bearings and meteorological measurements refine the next 'hop' trajectory. Once at the gully/outflow region, GPR and Raman soundings continue while the camera obtains detailed, approx. 0.5 cm images for geomorphology studies. The WOBBLE concept is applicable to Mars Scout, Mars Surveyor, or Discovery class missions.
Author
Mars Exploration; Mars Missions; Mars Surface; Mars Landing Sites; Balloon-Borne Instruments; Balloon Sounding

20030022668 NASA Glenn Research Center, Cleveland, OH, USA
Colonization of Venus
Landis, Geoffrey A.; [2003]; 6 pp.; In English; Conference on Human Space Exploration, Space Technology and Applications International Forum, 2-6 Feb. 2003, Albuquerque, NM, USA
Contract(s)/Grant(s): RTOP 755-A4-02
Report No.(s): E-13685; No Copyright; Avail: CASI; A02, Hardcopy

Although the surface of Venus is an extremely hostile environment, at about 50 kilometers above the surface the atmosphere of Venus is the most earthlike environment (other than Earth itself) in the solar system. It is proposed here that in the near term, human exploration of Venus could take place from aerostat vehicles in the atmosphere, and that in the long term, permanent settlements could be made in the form of cities designed to float at about fifty kilometer altitude in the atmosphere of Venus.
Author
Venus Atmosphere; Airships; Space Colonies; Planetary Bases; Venus (Planet)

20030022784 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Polar Wander on Triton and Pluto Due to Volatile Migration
Rubincam, David Parry; [2002]; 39 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Polar wander may occur on Triton and Pluto because of volatile migration. Triton, with its low obliquity, can theoretically sublimate volatiles (mostly nitrogen) at the rate of approximately 10(exp 14) kilograms per year from the equatorial regions and deposit them at the poles. Assuming Triton to be rigid on the sublimation timescale, after approximately 10(exp 5) years the polar caps would become large enough to cancel the rotational flattening, with a total mass equivalent to a global layer approximately 120-250 m in depth. At this point the pole wanders about the tidal bulge axis, which is the line joining Triton and Neptune. Rotation about the bulge axis might be expected to disturb the leading side/trailing side cratering statistics. Because no such disturbance is observed, it may be that Triton's mantle viscosity is too high but its surface volatile inventory is too low to permit wander. On the other hand, its mantle viscosity might be low, so that any uncompensated cap load might be expected to wander toward the tidal bulge axis. In this case, the axis of wander passes through the equator from the leading side to the trailing side; rotation about this wander axis would not disturb the cratering statistics. Low-viscosity polar wander may explain the bright southern hemisphere: this is the pole which is wandering toward the equator. In any case the permanent polar caps may be geologically very young. Polar wander may possibly take place on Pluto, due to its obliquity oscillations and perihelion-pole geometry. However, Pluto is probably not experiencing any wander at present. The Sun has been shining strongly on the poles over the last half of the obliquity cycle, so that volatiles should migrate to the equator, stabilizing the planet against wander. Spacecraft missions to Triton and Pluto which measure the dynamical flattening could give information about the accumulation of volatiles at the poles. Such information is best obtained by measuring gravity and topography from

orbiters, as was done for Mars with the highly successful Mars Global Surveyor.
Author
Triton; Planetary Orbits; Polar Wandering (Geology); Volatility; Pluto (Planet)

20030022791 NASA Glenn Research Center, Cleveland, OH, USA
Venus Atmospheric Exploration by Solar Aircraft
Landis, Geoffrey A.; LaMarre, C.; Colozza, A.; [2002]; 8 pp.; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 22-755-60-02; RTOP 755-A4-02
Report No.(s): IAC-02-Q.4.2.03; Copyright; Avail: CASI; A02, Hardcopy

The Venus atmosphere is a favorable environment for flying powered aircraft. The atmospheric pressure makes flight much easier than on planets such as Mars. Above the clouds, solar energy is available in abundance on Venus, and the slow rotation of Venus allows a solar airplane to be designed for flight within continuous sunlight. The atmosphere between 50 km and 75 km on Venus is one of the most dynamic and interesting regions of the planet. The challenge for a Venus aircraft will be the fierce winds and caustic atmosphere. In order to remain on the sunlit side of Venus, an exploration aircraft will have to be capable of sustained flight at or above the wind speed. An aircraft would be a powerful tool for exploration. By learning how Venus can be so similar to Earth, and yet so different, we will learn to better understand the climate and geological history of the Earth.
Author
Venus Atmosphere; Solar Powered Aircraft; Space Exploration

20030025769 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center
Karpati, Gabriel; Martin, John; Steiner, Mark; Reinhardt, K.; [2002]; 11 pp.; In English; IEEE Aerospace Conference, 8-14 Mar. 2003, Big Sky, MT, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

NASA Goddard has used its Integrated Mission Design Center (IMDC) to perform more than 150 mission concept studies. The IMDC performs rapid development of high-level, end-to-end mission concepts, typically in just 4 days. The approach to the studies varies, depending on whether the proposed mission is near-future using existing technology, mid-future using new technology being actively developed, or far-future using technology which may not yet be clearly defined. The emphasis and level of detail developed during any particular study depends on which timeframe (near-, mid-, or far-future) is involved and the specific needs of the study client. The most effective mission studies are those where mission capabilities required and emerging technology developments can synergistically work together; thus both enhancing mission capabilities and providing impetus for ongoing technology development.
Author
Mission Planning; Space Missions; Space Shuttles

20030032178 NASA Ames Research Center, Moffett Field, CA, USA NASA Goddard Space Flight Center, Greenbelt, MD, USA
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue
Gudipati, Murthy S.; Dworkin, Jason P.; Chillier, Xavier D. F.; Allamandola, Louis J.; Astrophysical Journal. Article 56474; January 20, 2003; Volume 583, No. 1, pp. 1-10; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC2-1303; 344-38-12-04; 344-50-92-02; Copyright; Avail: Other Sources

Here we report a study of the optical luminescent properties for a variety of vacuum-ultraviolet (VUV)-irradiated cosmic ice analogs and the complex organic residues produced. Detailed results are presented for the irradiated, mixed molecular ice: H2O: CH3OH:NH3:CO(100:50:1:1), a realistic representation for an interstellar/precometary ice that reproduces all the salient infrared spectral features associated with interstellar ices. The irradiated ices and the room-temperature residues resulting from this energetic processing have remarkable photoluminescent properties in the visible (520-570 nm). The luminescence dependence on temperature, thermal cycling, and VUV exposure is described. It is suggested that this type of luminescent behavior might be applicable to solar system and interstellar observations and processes for various astronomical objects with an ice heritage. Some examples include grain temperature determination and vaporization rates, nebula radiation balance, albedo values, color analysis, and biomarker identification.
Author
Cosmochemistry; Interstellar Matter; Ice; Molecular Spectroscopy; Ultraviolet Spectroscopy; Interstellar Chemistry; Far Ultraviolet Radiation; Spectral Reflectance; Photoluminescence

92
SOLAR PHYSICS

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

20030022667 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002
Cane, H. V.; Richardson, I. G.; Journal of Geophysical Research; [2003]; ISSN 0148-0227; 20 pp.; In English
Contract(s)/Grant(s): NCC5-180; Copyright; Avail: CASI; A03, Hardcopy

We summarize the occurrence of interplanetary coronal mass injections (ICMEs) in the near-Earth solar wind during 1996-2002, corresponding to the increasing and maximum phases of solar cycle 23. In particular, we give a detailed list of such events. This list, based on in-situ observations, is not confined to subsets of ICMEs, such as magnetic clouds or those preceded by halo CMEs observed by the SOHO/LASCO coronagraph, and provides an overview of 214 ICMEs in the near-Earth solar wind during this period. The ICME rate increases by about an order of magnitude from solar minimum to solar maximum (when the rate is approximately 3 ICMEs/solar rotation period). The rate also shows a temporary reduction during 1999, and another brief, deeper reduction in late 2000-early 2001, which only approximately track variations in the solar 10 cm flux. In addition, there are occasional periods of several rotations duration when the ICME rate is enhanced in association with high solar activity levels. We find an indication of a periodic variation in the ICME rate, with a prominent period of approximately 165 days similar to that previously reported in various solar phenomena. It is found that the fraction of ICMEs that are magnetic clouds has a solar cycle variation, the fraction being larger near solar minimum. For the subset of events that we could associate with a CME at the Sun, the transit speeds from the Sun to the Earth were highest after solar maximum.
Author
Coronal Mass Ejection; Interplanetary Medium; Solar Wind; Solar Prominences

20030025725 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Two Components in Major Solar Particle Events
White, Nicholas E., Technical Monitor; Cane, H. V.; vonRosenvinge, T. T.; Cohen, C. M. S.; Mewaldt, R. A.; [2003]; 15 pp.; In English
Contract(s)/Grant(s): NAG5-6912; Copyright; Avail: CASI; A03, Hardcopy

A study has been made of 29 intense, solar particle events observed in the energy range 25-100 MeV/nuc near Earth in the years 1997 through 2001. It is found that the majority of the events (19/29) had Fe to O ratios which were reasonably constant with time and energy, and with values above coronal. These all originated on the Sun s western hemisphere and most had intensities that rose rapidly at the time of an associated flare, and coronal mass ejection (CME), and then decayed more gradually. Few interplanetary shocks were observed during these increases. The spectra were mainly power laws. The remaining 10 events had different intensity-time profiles and Fe to O ratios that varied with time and energy with values at or below coronal. Most of these originated near central meridian and 6 had strong interplanetary shocks that were observed near Earth. In general the spectra were not power laws but steepened at high energies, particularly for Fe. There were four events with two peaks in the intensity-time profiles, the first near the time of the associated flare and the other at shock passage. The results, considered in the light of other recent work, suggest that the high energy particles that occur shortly after flares are indeed flare particles. At the highest rigidities considered here shock-accelerated particles are uncommon and are observed only in association with unusually fast shocks.
Author
Solar Flares; Coronal Mass Ejection; Particle Energy; Solar Corpuscular Radiation

93
SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

20030025711 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation
Mitchell, J. W.; Abe, K.; Anraku, K.; Asaoka, Y.; Fujikawa, M.; Fuke, H.; Haino, S.; Hams, T.; Ikeda, N.; Imori, M.; December 09, 2002; 6 pp.; In English
Contract(s)/Grant(s): RTOP 188-05-10-01
Report No.(s): H0.2-E0.2-0006-02; Copyright; Avail: CASI; A02, Hardcopy

The Balloon Borne Experiment with a Superconducting Spectrometer (BESS) has measured the energy spectrum of cosmic-ray antiprotons between 0.18 and 4.20 GeV in eight flights between 1993 and 2002. Above about 1 GeV, models in which antiprotons are secondary products of the interactions of primary cosmic rays with the interstellar gas agree with the BESS antiproton spectrum. Below 1 GeV, the data show a possible excess antiproton flux compared to secondary model predictions, suggesting the presence of an additional source of antiprotons. The antiproton/proton ratios measured between 1993 and 1999, during the Sun's positive-polarity phase, are consistent with simple models of solar modulation. However, results from the 2000 flight, following the solar magnetic field reversal, show a sudden increase in the antiproton/proton ratio and tend to favor a charge-sign-dependent drift model. To extend BESS measurements to lower energies, an evolutionary instrument, BESS-Polar, is under construction for polar flight in 2004.
Author
Antiprotons; Cosmic Rays; Energy Spectra; Solar Physics

20030032176 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Orbit Determination Support for the Microwave Anisotropy Probe (MAP)
Truong, Son H.; Cuevas, Osvaldo O.; Slojkowski, Steven; January 2003; 3 pp.; In English; 13th Annual AAS/AIAA Space Flight Mechanics Meeting, 9-12 Feb. 2003, Ponce, Puerto Rico; Copyright; Avail: CASI; A01, Hardcopy

THe microwave Anisotropy Probe (MAP) ia the second Medium Class Explorer (MIDEX) mission of the National Aeronautics and Space Administration (NASA). The main goal of the MAP observatory is to measure the temperature fluctuations, known as anisotropy, of the cosmic microwave background (CBG) radiation over the entire sky and to produce a map of the CMB anisotropies with an angular resolution of approximately 3 degrees. MAP was launched from the Cape Canaveral Air Force Station Complex 17 aboard a Delta II 7425-10 expendable launch vehicle at exactly 19:46:46.183 UTC on June 30, 20001. The spacecraft receiver a nominal direct insertion by the Delta expendable launch vehicle into a 185-km circular orbit with a 28.7 deg. inclination. MAP was than maneuvered into a sequence of phasing loops designed to set up a lunar gravity-assisted acceleration of the spacecraft onto a transfer trajectory to a lissajous orbit about the Earth-Sun L2 Lagrange point, about 1.5 million km from Earth. The science mission minimum lifetime is two years of observations at L2 with a desired lifetime of 4 years. The MAP transfer orbit consisted of 3.5 phasing loops.The MAP trajectory schematic all the way through L2 is shown. The first loop had a period of 7 days, the second and third loops were 10 days long, and the last half loop was 5 days. The periselene (i.e., lunar encounter or swingby) took place approximately 30 days after launch. After the periselene, the spacecraft cruised for approximately 60 days before it arrived in the vicinity of the L2 libration point. Two mid-course correction (MCC) maneuvers were performed to refine MAP's post-launch trajectory-one after periselene and one prior to arrival at vicinity of L2. Now that MAP is at its operational L2 lissajous orbit, the MAP satellite is commanded to perform occasional station-keeping (SK) maneuvers in order to maintain its orbit around L2. Because of its complex orbital characteristics, the mission provided a unique challenge to orbit determination (OD) support in many orbital regimes.
Author
Orbit Determination; Microwave Anisotropy Probe; Temperature Measurement; Anisotropy; Cosmic Microwave Background Radiation; Mapping; Angular Resolution

99
GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20030022716 Columbia Univ., New York, NY, USA
The Institute on Climate and Planets (ICP): A Research Education Program
Carlson, Barbara, Technical Monitor; [2003]; 18 pp.; In English
Contract(s)/Grant(s): NCC5-549
Report No.(s): CU-OPG-4888; No Copyright; Avail: CASI; A03, Hardcopy

Giving students a fair start to become productive and responsible contributors in the 21st century workforce and society depends on our ability to help them develop: (1) A global view of the world; (2) Problem-solving and/or reasoning abilities; (3) Basic scientific and technical literacy; and (4) A multi-disciplinary understanding of how humans and nature interact with the earth system. The Institute on Climate and Planets (ICP) in New York City is NASA Goddard Institute for Space Studies' (GISS) response to the national challenge to give students a fair start to become productive in America's workforce and

society, GISS is part of the Earth Science Director at NASA Goddard Space Flight Center in Maryland and a component of Columbia University's Earth Institute, a university-wide initiative whose mission is to understand our planet so as to enhance its sustainability. In 1994 Jim Hansen, several of his GISS and Columbia University colleagues and Fitzgerald Bramwell, the former Director of the New York City Alliance for Minority Participation at City University of New York, launched the ICP. ICP contributes to NASA education and minority outreach goals by directly involving underrepresented college, high school and junior high school students and their educators in research. ICP takes advantage of the interest of many civil servants and Columbia University research scientists at GISS to involve students and educators on multi-level research teams working on problems at the core of NASA's Earth Science Enterprise - advancing our understanding of Earth s climate, climate variability, and climate impacts.
Author
Students; Universities; Minorities; Education; Climate Change

20030025776 NASA Langley Research Center, Hampton, VA, USA
The Contributions of Vincent Justus Burnelli
Wood, Richard M.; [2003]; 12 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-0292; No Copyright; Avail: CASI; A03, Hardcopy

A review of the contributions and the professional life of Vincent Justus Burnelli are presented. Burnelli was an inventor, aircraft designer and a leading pioneer in early aviation within the USA. A discussion of many of his leading accomplishments are discussed, including his design of the first commercial twin engine transport, invent of the lifting-body/lifting-fuselage aircraft. He was one of the first to put into practice retractable landing gear, variable area and camber wings, winglets, and full span flaps for twin engine aircraft. A review of a number of his sixty patents is presented and discussed as they relate to his eleven aircraft designs that were produced. A brief discussion of his accomplishments and contributions, as they relate to present aircraft design trends is also presented.
Author
Biography; Aircraft Design; Inventions

Subject Term Index

ABEL FUNCTION

The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

ABORT TRAJECTORIES

Designing Phase 2 for the Double-Lunar Swingby of the Magnetospheric Multiscale Mission (MMS) – 27

ABSORPTION SPECTRA

Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

The -145 km/s Absorption System of Eta Carinae – 118

The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

ACCELERATED LIFE TESTS

Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

ACCRETION DISKS

Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay – 119

ACETIC ACID

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

ACIDITY

Alumina Volatility in Water Vapor at Elevated Temperatures – 40

ACOUSTICS

Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

ACTIVE CONTROL

Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

Recent Progress in Engine Noise Reduction Technologies – 107

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

ACTIVE GALACTIC NUCLEI

Progress in Search for Antihelium with BESS – 66

ACTIVE GALAXIES

The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

ACTUATORS

Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

ADATOMS

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

ADDITIVES

Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

ADIABATIC CONDITIONS

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

ADVANCED VERY HIGH RESOLUTION RADIOMETER

Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

ADVECTION

Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

AEROACOUSTICS

Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

AERODYNAMIC COEFFICIENTS

Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

AERODYNAMIC CONFIGURATIONS

Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

AERODYNAMIC NOISE

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

AERODYNAMIC STALLING

Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

AERODYNAMICS

Benchmark Problems for Space Mission Formation Flying – 54

Recent Enhancements to the National Transonic Facility – 9

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

AEROELASTICITY

Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

AEROGELS

Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

AEROSOLS

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Effects of Non-Sphericity on Mineral Dust Modeling – 71

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

AEROSPACE ENGINEERING

Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

Timekeeping for the Space Technology 5 (ST-5) Mission – 26

AEROSPACE ENVIRONMENTS

A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

Living with a Star Space Environment Testbed – 8

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

AEROSPACE SYSTEMS

High Voltage Space Solar Arrays – 9

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

AFRICA

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

AFTERGLOWS

Strategies for Studying the Sources of Gamma Ray Bursts – 118

AGING (MATERIALS)

Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

AGROMETEOROLOGY

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

AIR BREATHING ENGINES

Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

AIR LAND INTERACTIONS

Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

AIR TRANSPORTATION

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

AIRBORNE EQUIPMENT

Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

AIRBORNE/SPACEBORNE COMPUTERS

Onboard Processor for Compressing HSI Data – 17

AIRCRAFT DESIGN

The Contributions of Vincent Justus Burnelli – 133

AIRCRAFT ENGINES

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

Recent Progress in Engine Noise Reduction Technologies – 107

Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

AIRFOIL PROFILES

Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

AIRSHIPS

Colonization of Venus – 129

ALGORITHMS

A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

Automating the Processing of Earth Observation Data – 66

Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Collectives for the Optimal Combination of Imperfect Objects – 105

Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

Recursive Hierarchical Image Segmentation by Region Growing and Constrained Spectral Clustering – 101

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Spacecraft Angular State Estimation After Sensor Failure – 98

Validation of Agent Based Distillation Movement Algorithms – 102

ALLOYING

Directional Solidification and Convection in Small Diameter Crucibles – 41

ALLOYS

Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

ALTITUDE

Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

ALUMINUM ALLOYS

Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

ALUMINUM OXIDES

Alumina Volatility in Water Vapor at Elevated Temperatures – 40

AMAZON REGION (SOUTH AMERICA)

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

AMPLITUDES

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

ANALOGIES

A Generalized Acoustic Analogy – 7

ANGULAR RESOLUTION

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 132

ANGULAR VELOCITY

Spacecraft Angular State Estimation After Sensor Failure – 98

ANISOTROPY

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 132

ANNUAL VARIATIONS

Causes of Long-Term Drought in the USA Great Plains – 86

Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

ANOMALIES

LEO Spacecraft Charging Guidelines – 17

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

Satellite GN and C Anomaly Trends – 15

ANTARCTIC REGIONS

On the Size of the Antarctic Ozone Hole – 65

ANTENNA ARRAYS

K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

ANTENNA DESIGN

Multi-Beam Phased Array Antennas – 45

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

ANTIPROTONS

Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

APERTURES

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Large Coded Aperture Mask for Space-flight Hard X-ray Images – 21

APPLICATIONS PROGRAMS (COMPUTERS)

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

Human Centered Design and Development for NASA's MerBoard – 100

Internet Technology for Future Space Missions – 15

Onboard Processor for Compressing HSI Data – 17

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Recursive Hierarchical Image Segmentation by Region Growing and Constrained Spectral Clustering – 101

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

ARCHITECTURE (COMPUTERS)

Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming – 101

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

ARCTIC OCEAN

Space/Time Statistics of Polar Ice Motion – 77

ARITHMETIC

Arithmetic Data Cube as a Data Intensive Benchmark – 103

ARTIFICIAL INTELLIGENCE

Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry – 103

Sensor Web and Intelligent Sensors for Earth Science Applications – 60

The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

ARTIFICIAL SATELLITES

Satellite Servicing in Mission Design Studies at the NASA GSFC – 21

ASIA

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

ASTRONAUTICS

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

ASTRONAUTS

Agent Interaction with Human Systems in Complex Environments: Requirements for Automating the Function of CapCom in Apollo 17 – 96

ASTRONOMICAL MAPS

A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

ASTRONOMICAL MODELS

Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

ASTRONOMICAL OBSERVATORIES

Distributed Framework for Dynamic Telescope and Instrument Control – 52

ASTRONOMY

US Astronomers Access to SIMBAD in Strasbourg, France – 114

ASTROPHYSICS

Atomic Data for the K-Vacancy States of Fe XXIV – 121

Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

Resource Letter GrW-1: Gravitational Waves – 127

The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

ASYMMETRY

Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

ATLANTIC OCEAN

Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

ATMOSPHERIC CHEMISTRY

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

ATMOSPHERIC CIRCULATION

Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

ATMOSPHERIC COMPOSITION

Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

ATMOSPHERIC EFFECTS
The Sun's Impact on Climate – 73

ATMOSPHERIC GENERAL CIRCULATION MODELS
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Causes of Long-Term Drought in the USA Great Plains – 86

Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

ATMOSPHERIC HEATING
Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

ATMOSPHERIC MODELS
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Effects of Non-Sphericity on Mineral Dust Modeling – 71

Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Tropospheric Wind Observations with Doppler Lidars – 74

ATMOSPHERIC RADIATION
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

ATMOSPHERIC SOUNDING
Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Monthly Report of the Meteorological Satellite Center: December 2002 – 82

Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

ATMOSPHERIC TEMPERATURE
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

ATOMIC EXCITATIONS
Atomic Data for the K-Vacancy States of Fe XXIV – 121

ATTITUDE CONTROL
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Multiple Autonomous Discrete Event Controllers for Constellations – 14

On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

ATTITUDE (INCLINATION)
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

AUGER EFFECT
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

AUGER SPECTROSCOPY
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

AUTOMATIC CONTROL
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Multiple Autonomous Discrete Event Controllers for Constellations – 14

The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

AUTOMATION
Automating the Processing of Earth Observation Data – 66

AUTONOMOUS NAVIGATION
Relative Navigation of Formation-Flying Satellites – 17

AUTONOMOUS SPACECRAFT CLOCKS
Timekeeping for the Space Technology 5 (ST-5) Mission – 26

AUTONOMY
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Multiple Autonomous Discrete Event Controllers for Constellations – 14

NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft – 8

AXIAL STRAIN
Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

AXISYMMETRIC FLOW
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

BACKSCATTERING
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

BALLOON SOUNDING
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

BALLOON-BORNE INSTRUMENTS
Balloon Borne Arc-Second Pointer Feasibility Study – 25

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

BALLOONS
An Overview of the NASA Sounding Rocket and Balloon Programs – 3

BAND STRUCTURE OF SOLIDS
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

BANDWIDTH
Development of a Thrust Stand to Meet LISA Mission Requirements – 29

Effective Frequency Technique – 106

BATTERY CHARGERS
Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

BIAS
Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

BINARY STARS
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

BIOGEOCHEMISTRY
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

BIOGRAPHY
The Contributions of Vincent Justus Burnelli – 133

BIOMASS BURNING
A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

BIOMASS
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

BLACK HOLES (ASTRONOMY)
An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay – 119

What can we learn about cosmic structure from gravitational waves? – 120

X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

BLUNT LEADING EDGES
Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

BORON ALLOYS
Site Occupancy of Ternary Additions to B2 Alloys – 39

BORON NITRIDES
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

BOUNDARY CONDITIONS
HEASARC Software Archive – 98

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

BOUNDARY LAYER CONTROL
Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

BOUNDARY VALUE PROBLEMS
Further Developments in the MLPG Method for Beam Problems – 57

BRAIN
Neural Dynamics Underlying Event-Related Potentials – 95

BRAZING
Flaw Tolerance in Lap Shear Brazed Joints – 54

Flaw Tolerance In Lap Shear Brazed Joints – 57

BROMINE COMPOUNDS
On the Size of the Antarctic Ozone Hole – 65

BUBBLES
Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

BURSTS
State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay – 119

C (PROGRAMMING LANGUAGE)
Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming – 101

CALCULUS OF VARIATIONS
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

CALIBRATING
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset – 15

Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

CALORIMETERS
Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

CAMERAS
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

CANTILEVER BEAMS
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

CAPACITANCE-VOLTAGE CHARACTERISTICS
NiH2 Cycle Life Study – 47

CAPACITORS
Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

CAPILLARY TUBES
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

CARBON CYCLE
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

CARBON DIOXIDE CONCENTRATION
Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

CARBON FIBER REINFORCED PLASTICS
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

CARBON FIBERS
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

CARBON MONOXIDE
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

CARBON-CARBON COMPOSITES
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

CARBON
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Climate Controls on Carbon Sequestration in Eastern North America – 92

Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

CATACLYSMIC VARIABLES
The Origin of Soft X-rays in DQ Herculis – 122

Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

CERAMIC COATINGS
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

CERAMIC MATRIX COMPOSITES
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

CHARGE EFFICIENCY

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

CHARGED PARTICLES

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

CHEMICAL PROPULSION

Catalyzed Ignition of Bipropellants in Microtubes – 29

Magnetic Flux Compression Experiments Using Plasma Armatures – 32

CHEMICAL REACTIONS

A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Interstellar Antifreeze: Ethylene Glycol – 116

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

CHLORINE COMPOUNDS

On the Size of the Antarctic Ozone Hole – 65

CHLOROPHYLLS

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

CIRCULAR ORBITS

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

CITIES

A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

CLASSIFICATIONS

A Classification of Mediterranean Cyclones Based on Global Analyses – 85

CLIMATE CHANGE

A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Climate Controls on Carbon Sequestration in Eastern North America – 92

Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

The Institute on Climate and Planets (ICP): A Research Education Program – 132

The Sun's Impact on Climate – 73

CLIMATE MODELS

A New Look into the Effect of Large Drops on Radiative Transfer Process – 80

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 90

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

CLIMATE

A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

Chapman-1024 Processor Shared Memory – 100

MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

CLIMATOLOGY

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

Causes of Long-Term Drought in the USA Great Plains – 86

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Visions of our Planet's Atmosphere, Land & Oceans – 91

CLOUD COVER

Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

CLOUD PHYSICS

A New Look into the Effect of Large Drops on Radiative Transfer Process – 80

A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 90

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

CLOUDS (METEOROLOGY)

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

CMOS

Switching Oxide Traps – 47

COASTAL WATER

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

COASTS
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

COATINGS
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

COCKPIT WEATHER INFORMATION SYSTEMS
A Product Development Decision Model for Cockpit Weather Information Systems – 72

CODERS
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

COMBAT
Validation of Agent Based Distillation Movement Algorithms – 102

COMBUSTION CHAMBERS
Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

COMBUSTION CHEMISTRY
Catalyzed Ignition of Bipropellants in Microtubes – 29

COMBUSTION PHYSICS
Catalyzed Ignition of Bipropellants in Microtubes – 29

COMBUSTION PRODUCTS
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

COMBUSTION STABILITY
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

COMBUSTION
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

COMMAND AND CONTROL
Distributed Framework for Dynamic Telescope and Instrument Control – 52

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

COMMERCIAL OFF-THE-SHELF PRODUCTS
On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

COMMERCIALIZATION
Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

Technology Transfer/Commercialization Report – 113

COMMUNICATING
Implicit Communication in Novice and Expert Teams – 95

COMMUNICATION NETWORKS
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

COMMUNICATION
The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

COMPLEX SYSTEMS
Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

COMPONENTS
EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

COMPOSITE MATERIALS
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

COMPRESSIBILITY
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

COMPRESSIBLE FLOW
Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

COMPRESSIVE STRENGTH
Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

COMPUTATIONAL FLUID DYNAMICS
Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

Source Term Model for an Array of Vortex Generator Vanes – 50

Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

COMPUTATIONAL GRIDS
Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

COMPUTATION
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

The Anharmonic Force Field of BeH2 Revisited – 110

COMPUTER AIDED MAPPING
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

COMPUTER NETWORKS
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

COMPUTER PROGRAMMING
Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century – 97

The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

COMPUTER PROGRAMS
An Integrated Analysis-Test Approach – 102

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Foundations of the Bandera Abstraction Tools – 100

HEASARC Software Archive – 98

Task Analysis Technologies at KSC – 113

COMPUTER SYSTEMS DESIGN
Agent Interaction with Human Systems in Complex Environments: Requirements for Automating the Function of CapCom in Apollo 17 – 96

Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

COMPUTER SYSTEMS PERFORMANCE
Arithmetic Data Cube as a Data Intensive Benchmark – 103

Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

COMPUTERIZED SIMULATION

Causes of Long-Term Drought in the USA Great Plains – 86

Chapman-1024 Processor Shared Memory – 100

Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Site Occupancy of Ternary Additions to B2 Alloys – 39

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Tropospheric Wind Observations with Doppler Lidars – 74

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

CONDENSATION NUCLEI

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

CONDUCTION BANDS

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

CONDUCTIVE HEAT TRANSFER

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

CONICAL SCANNING

Holographic Optical Elements as Scanning Lidar Telescopes – 108

CONSERVATION LAWS

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

CONTINUOUS WAVE LASERS

LISA Optics Model – 53

CONTROL EQUIPMENT

Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

CONTROL SIMULATION

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

CONTROL SURFACES

Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

CONTROL SYSTEMS DESIGN

Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

CONTROLLERS

Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

CONVECTION-DIFFUSION EQUATION

Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

CONVECTION

Directional Solidification and Convection in Small Diameter Crucibles – 41

Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

CONVECTIVE FLOW

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

COOL STARS

Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

COPPER ALLOYS

An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

COPPER INDIUM SELENIDES

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

COPPER SULFIDES

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

COPPER

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

CORONAL MASS EJECTION

Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

Two Components in Major Solar Particle Events – 131

CORRECTION

Progress in Search for Antihelium with BESS – 66

CORRELATION

Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

COSMIC MICROWAVE BACKGROUND RADIATION

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 132

COSMIC RAY SHOWERS

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

COSMIC RAYS

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

COSMOCHEMISTRY

A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

COSMOLOGY

What can we learn about cosmic structure from gravitational waves? – 120

COST REDUCTION

A Virtual Mission Operations Center - Collaborative Environment – 11

Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

COUETTE FLOW

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

COUPLED MODES

Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

COUPLING

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

CRACK PROPAGATION

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

CROSS FLOW

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

CROSS SECTIONS

Production of Pions in pA-collisions – 112

CROSSLINKING

Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

CRUCIBLES

Directional Solidification and Convection in Small Diameter Crucibles – 41

CRYOGENIC TEMPERATURE

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

CRYOGENICS

A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Cryogenic Information Center – 34

CRYSTAL GROWTH

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

CUMULUS CLOUDS

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

CYCLES

A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

CYCLOGENESIS

A Classification of Mediterranean Cyclones Based on Global Analyses – 85

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

CYCLONES

A Classification of Mediterranean Cyclones Based on Global Analyses – 85

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

CYCLOTRON RESONANCE

New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

DAMAGE

An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

DATA ACQUISITION

Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

DATA BASES

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

US Astronomers Access to SIMBAD in Strasbourg, France – 114

DATA COMPRESSION

Onboard Processor for Compressing HSI Data – 17

DATA CORRELATION

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

DATA FLOW ANALYSIS

Distributed Framework for Dynamic Telescope and Instrument Control – 52

Onboard Processor for Compressing HSI Data – 17

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

DATA INTEGRATION

Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

DATA MINING

Living with a Star Space Environment Testbed – 8

Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

DATA PROCESSING EQUIPMENT

Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

DATA PROCESSING

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

An Integrated Analysis-Test Approach – 102

Automating the Processing of Earth Observation Data – 66

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

HEASARC Software Archive – 98

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

New Pulsars from Arecibo Drift Scan Searches – 118

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

DATA REDUCTION

Satellite GN and C Anomaly Trends – 15

DATA STORAGE

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

DATA TRANSFER (COMPUTERS)

Arithmetic Data Cube as a Data Intensive Benchmark – 103

DATA TRANSMISSION
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

DEBONDING (MATERIALS)
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

DECISION MAKING
A Product Development Decision Model for Cockpit Weather Information Systems – 72

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft – 8

DECISION SUPPORT SYSTEMS
A Virtual Mission Operations Center - Collaborative Environment – 11

DEFECTS
Flaw Tolerance in Lap Shear Brazed Joints – 54

DEGREES OF FREEDOM
A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

DELTA LAUNCH VEHICLE
Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

DELTA WINGS
Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

DENSITY MEASUREMENT
The Intercluster Medium in Clusters – 117

DEPOLARIZATION
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

DEPOSITION
Material Outgassing, Identification and Deposition, MOLIDEP System – 52

DESIGN ANALYSIS
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

LEO Spacecraft Charging Guidelines – 17

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

DESIGN OPTIMIZATION
Collectives for the Optimal Combination of Imperfect Objects – 105

Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

DESIGN
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

DESTRUCTIVE TESTS
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Status on Mechanical Testing at NASA GSFC – 54

DETECTORS
Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

DIAGNOSIS
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

DIELECTRICS
Switching Oxide Traps – 47

DIFFUSION FLAMES
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

DIRECT NUMERICAL SIMULATION
Source Term Model for an Array of Vortex Generator Vanes – 50

DIRECTIONAL SOLIDIFICATION (CRYSTALS)
Directional Solidification and Convection in Small Diameter Crucibles – 41

DISPLAY DEVICES
Human Centered Design and Development for NASA's MerBoard – 100

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

DISTRIBUTED MEMORY
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

DISTRIBUTED PROCESSING
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

DISTRIBUTION FUNCTIONS
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

DOCUMENT MARKUP LANGUAGES
Distributed Framework for Dynamic Telescope and Instrument Control – 52

DOCUMENTS
HEASARC Software Archive – 98

DOMAINS
Foundations of the Bandera Abstraction Tools – 100

DROPS (LIQUIDS)
The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

DROUGHT
Causes of Long-Term Drought in the USA Great Plains – 86

DRYING
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

DUCTS
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

DUST
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Effects of Non-Sphericity on Mineral Dust Modeling – 71

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

DYNAMIC CONTROL
Benchmark Problems for Space Mission Formation Flying – 54

Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

Development of a Thrust Stand to Meet LISA Mission Requirements – 29

Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

DYNAMIC MODELS
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

DYNAMIC PRESSURE
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

DYNAMIC RESPONSE
A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Development of a Thrust Stand to Meet LISA Mission Requirements – 29

DYNAMIC STRUCTURAL ANALYSIS

A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

DYNAMIC TESTS

Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

EARTH ATMOSPHERE

The Sun's Impact on Climate – 73

Visions of our Planet's Atmosphere, Land & Oceans – 91

EARTH CRUST

Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

EARTH GRAVITATION

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

EARTH LIMB

Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

EARTH MAGNETOSPHERE

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

EARTH MANTLE

Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

EARTH OBSERVATIONS (FROM SPACE)

A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Automating the Processing of Earth Observation Data – 66

EARTH OBSERVING SYSTEM (EOS)

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

EARTH ORBITS

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

EARTH RESOURCES

Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

EARTH ROTATION

Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

EARTH SCIENCES

Automating the Processing of Earth Observation Data – 66

Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Sensor Web and Intelligent Sensors for Earth Science Applications – 60

Visions of our Planet's Atmosphere, Land & Oceans – 91

ECONOMIC ANALYSIS

Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

ECOSYSTEMS

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Climate Controls on Carbon Sequestration in Eastern North America – 92

Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

EDUCATION

Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century – 97

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

Science Through ARts (STAR) – 112

Systems Engineering Education Development(SEED)Case Study – 113

The Institute on Climate and Planets (ICP): A Research Education Program – 132

EIGENVECTORS

Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

EINSTEIN EQUATIONS

Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

EJECTA

Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

ELECTRIC EQUIPMENT

EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

ELECTRIC FIELDS

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

ELECTRIC POTENTIAL

NiH2 Cycle Life Study – 47

ELECTRICAL IMPEDANCE

Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

ELECTRICAL RESISTIVITY

Magnetic Flux Compression Experiments Using Plasma Armatures – 32

Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

ELECTRODES

NiH2 Cycle Life Study – 47

ELECTRODYNAMICS

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

ELECTROLYTES

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

ELECTROMAGNETIC COMPATIBILITY

Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

ELECTROMAGNETIC PROPULSION

On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

ELECTROMAGNETISM

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

ELECTROMECHANICAL DEVICES

EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

ELECTRON MOBILITY

High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

ELECTRON STATES

A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

ELECTRON TRANSITIONS

A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

ELECTRONIC EQUIPMENT

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

ELLIPSOIDS

Effects of Non-Sphericity on Mineral Dust Modeling – 71

ELLIPTIC DIFFERENTIAL EQUATIONS

Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

ELLIPTICAL ORBITS

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

EMITTANCE

Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

EMITTERS

A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies – 125

EMULSIONS

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

ENCAPSULATED MICROCIRCUITS

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

ENERGETIC PARTICLES

Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

ENERGY BUDGETS

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

ENERGY CONSUMPTION

Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

ENERGY CONVERSION

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

ENERGY GAPS (SOLID STATE)

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

ENERGY LEVELS

Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

ENERGY SPECTRA

Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

ENGINE NOISE

Recent Progress in Engine Noise Reduction Technologies – 107

Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

ENVIRONMENT EFFECTS

A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

Living with a Star Space Environment Testbed – 8

ENVIRONMENT MODELS

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

ENVIRONMENT SIMULATION

Modeling and Simulation for Mission Operations Work System Design – 115

EPITAXY

Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

EQUATIONS OF MOTION

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

EQUATIONS OF STATE

A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

ERROR ANALYSIS

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

ERRORS

Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

Singular Vectors for Moisture-Measuring Norms – 92

ESTIMATING

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

ETHYL ALCOHOL

Interstellar Antifreeze: Ethylene Glycol – 116

ETHYLENE COMPOUNDS

Interstellar Antifreeze: Ethylene Glycol – 116

EULER EQUATIONS OF MOTION

A Generalized Acoustic Analogy – 7

EULER-BERNOULLI BEAMS

Further Developments in the MLPG Method for Beam Problems – 57

EVAPORATION RATE

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

EVAPORATION

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

EVAPORATORS

Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

EXHAUST EMISSION

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

EXPANSION

Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

EXPERIMENT DESIGN

Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

EXPOSURE

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

EXTRACTION

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

EXTRAPOLATION

Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

EXTRATERRESTRIAL RADIATION

A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

FABRICATION

Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

FAILURE ANALYSIS

LEO Spacecraft Charging Guidelines – 17

FAILURE MODES

Flaw Tolerance in Lap Shear Brazed Joints – 54

Task Analysis Technologies at KSC – 113

FAILURE

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Flaw Tolerance in Lap Shear Brazed Joints – 54

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

FAR INFRARED RADIATION

Distributed Framework for Dynamic Telescope and Instrument Control – 52

Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

FAR ULTRAVIOLET RADIATION

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

FATIGUE LIFE

Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

FATIGUE (MATERIALS)

Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

FATIGUE TESTS

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

FAULT TOLERANCE

Flaw Tolerance in Lap Shear Brazed Joints – 54

Flaw Tolerance In Lap Shear Brazed Joints – 57

FEASIBILITY ANALYSIS

Balloon Borne Arc-Second Pointer Feasibility Study – 25

FEEDBACK CONTROL

An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

FERMENTATION

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

FERROELECTRICITY

K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

FIBER COMPOSITES

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

FIELD EFFECT TRANSISTORS

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Where is scattering important in nanotransistors? – 46

FIELD EMISSION

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

FIELD THEORY (PHYSICS)

The Anharmonic Force Field of BeH2 Revisited – 110

FILE MAINTENANCE (COMPUTERS)

The Goddard VLBI SINEX Files – 101

FILMS

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

FINITE ELEMENT METHOD

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

FLAPPING

Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

FLIGHT TESTS

Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

FLIGHT VEHICLES

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

FLOW DISTRIBUTION

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

FLOW VELOCITY

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

Source Term Model for an Array of Vortex Generator Vanes – 50

FLUID DYNAMICS

The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

FLUID FLOW

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

Source Term Model for an Array of Vortex Generator Vanes – 50

FLUORESCENCE

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

FLUX DENSITY

Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

FLUX DIFFERENCE SPLITTING

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

FORCE DISTRIBUTION

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

FORECASTING

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Singular Vectors for Moisture-Measuring Norms – 92

FORMATION FLYING

A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

Benchmark Problems for Space Mission Formation Flying – 54

Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Navigation Guidelines for Orbital Formation Flying Missions – 16

Relative Navigation of Formation-Flying Satellites – 17

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

FOUNDRIES

A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

FOURIER TRANSFORMATION

The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

FREE CONVECTION

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

FREQUENCIES

Effective Frequency Technique – 106

FUEL CONTROL

A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

GALACTIC CLUSTERS

A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies – 125

The Intercluster Medium in Clusters – 117

GALACTIC COSMIC RAYS

Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

GALACTIC EVOLUTION

Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

The Intercluster Medium in Clusters – 117

GALAXIES

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

The Complete Z-diagram of LMC X-2 – 117

GALERKIN METHOD

Further Developments in the MLPG Method for Beam Problems – 57

GALLIUM ARSENIDES

Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

GAMMA RAY BURSTS

Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

Strategies for Studying the Sources of Gamma Ray Bursts – 118

The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

GAMMA RAYS

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

GAS COMPOSITION

Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

GAS FLOW

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

GENERAL OVERVIEWS

An Overview of the NASA Sounding Rocket and Balloon Programs – 3

GENOME

Redundancies in Large-scale Protein Interaction Networks – 94

GEOMAGNETISM

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

GEOPHYSICAL FLUIDS

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

GEOPHYSICS

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

GEOSAT SATELLITES

Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

GERMANIUM

Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

GLACIERS

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

GLASS

A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

GLOBAL POSITIONING SYSTEM

Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset – 15

Relative Navigation of Formation-Flying Satellites – 17

GLOBAL WARMING

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

The Sun's Impact on Climate – 73

GLOW DISCHARGES

Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

GLYCINE

A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

GLYCOLS

Interstellar Antifreeze: Ethylene Glycol – 116

GOES SATELLITES

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

GRAIN SIZE

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

GRANULAR MATERIALS
Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

GRAPHITE-EPOXY COMPOSITES
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

GRAVITATIONAL COLLAPSE
The Intercluster Medium in Clusters – 117

GRAVITATIONAL EFFECTS
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

GRAVITATIONAL FIELDS
Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

GRAVITATIONAL WAVES
Resource Letter GrW-1: Gravitational Waves – 127

Strategies for Studying the Sources of Gamma Ray Bursts – 118

What can we learn about cosmic structure from gravitational waves? – 120

GRAVITATION
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

GRAVITY ANOMALIES
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

GREAT PLAINS CORRIDOR (NORTH AMERICA)
Causes of Long-Term Drought in the USA Great Plains – 86

GRID GENERATION (MATHEMATICS)
Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

GROUND BASED CONTROL
A Virtual Mission Operations Center - Collaborative Environment – 11

GROUND TRUTH
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

GROUP DYNAMICS
Implicit Communication in Novice and Expert Teams – 95

H II REGIONS
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

HAMILTONIAN FUNCTIONS
Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

HARDWARE-IN-THE-LOOP SIMULATION
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

HARDWARE
The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

HAZARDS
Radiation Requirements and Requirements Flowdown: Single Event Effects (SEEs) and Requirements – 22

HEAT FLUX
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

HEAT ISLANDS
A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

HEAT PIPES
Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

NASA Thermal Control Technologies for Robotic Spacecraft – 23

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

HEAT RESISTANT ALLOYS
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

HEAT STORAGE
NASA Thermal Control Technologies for Robotic Spacecraft – 23

HEAT TRANSFER
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

HEAT TREATMENT
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

HEATING EQUIPMENT
Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

HELICOPTERS
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

HELIOSPHERE
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

HELIUM ISOTOPES
Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores – 122

HELIUM
Progress in Search for Antihelium with BESS – 66

HERCULES NOVA
The Origin of Soft X-rays in DQ Herculis – 122

HIGH ALTITUDE
High Altitude Launch for a Practical SSTO – 12

HIGH ELECTRON MOBILITY TRANSISTORS
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

HIGH ENERGY ELECTRONS
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

HIGH FREQUENCIES
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

HIGH RESOLUTION
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

HIGH TEMPERATURE TESTS
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

HIGH TEMPERATURE

Alumina Volatility in Water Vapor at Elevated Temperatures – 40

Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

HIGH VOLTAGES

High Voltage Space Solar Arrays – 9

HOLES (ELECTRON DEFICIENCIES)

Switching Oxide Traps – 47

HOLES (MECHANICS)

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

HOLOGRAPHIC OPTICAL ELEMENTS

Holographic Optical Elements as Scanning Lidar Telescopes – 108

HOLOGRAPHY

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

HONEYCOMB STRUCTURES

Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

HORIZONTAL DISTRIBUTION

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

HUBBLE SPACE TELESCOPE

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

HUMAN BEHAVIOR

Implicit Communication in Novice and Expert Teams – 95

HUMAN FACTORS ENGINEERING

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

HUMAN-COMPUTER INTERFACE

Human Centered Design and Development for NASA's MerBoard – 100

HURRICANES

Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

HYBRID PROPULSION

Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

HYDROLOGICAL CYCLE

Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

HYDROLOGY MODELS

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

HYDROLOGY

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

HYDROMETEOROLOGY

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

HYDROSTATICS

Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

HYPERSONIC FLOW

Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

HYPERSONIC INLETS

Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

HYPERSONIC SPEED

Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

ICELAND

Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

ICE

Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores – 122

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

Space/Time Statistics of Polar Ice Motion – 77

IMAGE ANALYSIS

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

IMAGING SPECTROMETERS

Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

IMAGING TECHNIQUES

Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Recursive Hierarchical Image Segmentation by Region Growing and Constrained Spectral Clustering – 101

INCONEL (TRADEMARK)

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

INDENTATION

An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

INDIUM SULFIDES

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

INFERENCE

Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry – 103

INFORMATION ANALYSIS

Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft – 8

INFORMATION DISSEMINATION

Human Centered Design and Development for NASA's MerBoard – 100

INFORMATION RETRIEVAL
Cryogenic Information Center – 34

INFORMATION SYSTEMS
Multiple Autonomous Discrete Event Controllers for Constellations – 14

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

INFORMATION THEORY
Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry – 103

INFORMATION TRANSFER
Human Centered Design and Development for NASA's MerBoard – 100

INFRARED ASTRONOMY
Distributed Framework for Dynamic Telescope and Instrument Control – 52

INFRARED DETECTORS
Strategies for Studying the Sources of Gamma Ray Bursts – 118

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

INFRARED INTERFEROMETERS
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

INFRARED RADIATION
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

INFRARED SIGNATURES
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

INFRARED SPECTROMETERS
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

INSTRUMENT ERRORS
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

INSTRUMENT PACKAGES
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

INSULATION
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

INTEGRATED MISSION CONTROL CENTER
A Virtual Mission Operations Center - Collaborative Environment – 11

INTERCALATION
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

INTERCALIBRATION
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

INTERFERENCE
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

INTERFEROMETERS
Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

INTERFEROMETRY
Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

INTERMETALLICS
Site Occupancy of Ternary Additions to B2 Alloys – 39

INTERNATIONAL COOPERATION
US Astronomers Access to SIMBAD in Strasbourg, France – 114

INTERNATIONAL SPACE STATION
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

INTERNET RESOURCES
US Astronomers Access to SIMBAD in Strasbourg, France – 114

INTERNETS
Internet Technology for Future Space Missions – 15

INTEROPERABILITY
HEASARC Software Archive – 98

Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

INTERPLANETARY DUST
Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores – 122

INTERPLANETARY MEDIUM
Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

INTERSTELLAR CHEMISTRY
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

INTERSTELLAR MATTER
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Interstellar Antifreeze: Ethylene Glycol – 116

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

INVENTIONS
The Contributions of Vincent Justus Burnelli – 133

ION EMISSION
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

ION IMPLANTATION
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

IONS
Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

IRON COMPOUNDS
Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

IRON
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

ISOCYANATES
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

ISOTHERMAL PROCESSES
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

JAPAN
Monthly Report of the Meteorological Satellite Center: December 2002 – 82

JET AIRCRAFT NOISE
A Generalized Acoustic Analogy – 7

JET STREAMS (METEOROLOGY)
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

K LINES
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

KERNEL FUNCTIONS
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

LAND USE
Visions of our Planet's Atmosphere, Land & Oceans – 91

LAP JOINTS
Flaw Tolerance in Lap Shear Brazed Joints – 54

Flaw Tolerance In Lap Shear Brazed Joints – 57

LARGE SPACE STRUCTURES
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

LASER ALTIMETERS
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

LASER HEATING
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

LASER INTERFEROMETRY
Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

Strategies for Studying the Sources of Gamma Ray Bursts – 118

LATENT HEAT
Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

LATITUDE
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

LATTICE PARAMETERS
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

LAUNCH COSTS
Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

LAUNCH VEHICLES
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

LEAD ALLOYS
Directional Solidification and Convection in Small Diameter Crucibles – 41

LEADERSHIP
Systems Engineering Education Development(SEED)Case Study – 113

LEADING EDGES
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

LEARNING
Science Through ARts (STAR) – 112

LENSES
Multi-Beam Phased Array Antennas – 45

LIBRATION
Benchmark Problems for Space Mission Formation Flying – 54

LIFE (DURABILITY)
Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

NiH2 Cycle Life Study – 47

LIGHT CURVE
The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

LIGHT (VISIBLE RADIATION)
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

LINE SPECTRA
Effective Frequency Technique – 106

Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

LINEAR SYSTEMS
Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

LINEARIZATION
A Generalized Acoustic Analogy – 7

Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

LIQUID ROCKET PROPELLANTS
Catalyzed Ignition of Bipropellants in Microtubes – 29

LISA (OBSERVATORY)
Development of a Thrust Stand to Meet LISA Mission Requirements – 29

LISA Optics Model – 53

What can we learn about cosmic structure from gravitational waves? – 120

LITHIUM BATTERIES
Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

LOAD TESTS
NiH2 Cycle Life Study – 47

LOADS (FORCES)
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

Status on Mechanical Testing at NASA GSFC – 54

LOGIC PROGRAMMING
Collectives for the Optimal Combination of Imperfect Objects – 105

LOOPS
Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

LOW CONCENTRATIONS
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

LOW COST
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

LOW EARTH ORBITS
Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

LOW FREQUENCIES
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

LOW PASS FILTERS
Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

LOW PRESSURE
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

LOW SPEED
Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

LOW TEMPERATURE
Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

LOW THRUST PROPULSION
Catalyzed Ignition of Bipropellants in Microtubes – 29

LUNAR PHASES
Designing Phase 2 for the Double-Lunar Swingby of the Magnetospheric Multiscale Mission (MMS) – 27

MACH NUMBER
Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

MACHINE LEARNING
Collectives for the Optimal Combination of Imperfect Objects – 105

Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry – 103

MAGELLANIC CLOUDS

An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

MAGNETARS

New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

MAGNETIC ANOMALIES

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

MAGNETIC EFFECTS

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

MAGNETIC FIELD CONFIGURATIONS

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

MAGNETIC FIELDS

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

MAGNETIC FLUX

Magnetic Flux Compression Experiments Using Plasma Armatures – 32

MAGNETIC SPECTROSCOPY

Progress in Search for Antihelium with BESS – 66

MAGNETIC STARS

X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

MAGNETIC SURVEYS

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

MAGNETOHYDRODYNAMICS

Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

MAN MACHINE SYSTEMS

Agent Interaction with Human Systems in Complex Environments: Requirements for Automating the Function of CapCom in Apollo 17 – 96

Modeling and Simulation for Mission Operations Work System Design – 115

MANAGEMENT PLANNING

Task Analysis Technologies at KSC – 113

MANAGEMENT SYSTEMS

Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

MANY BODY PROBLEM

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

MAPPING

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 132

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

MARKET RESEARCH

Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

MARS EXPLORATION

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

MARS LANDING SITES

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

MARS MISSIONS

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

MARS SURFACE

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

MASKS

Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

MASS DISTRIBUTION

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

MASS TRANSFER

The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

MASS

The Complete Z-diagram of LMC X-2 – 117

MATERIALS HANDLING

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

MATERIALS SELECTION

High Altitude Launch for a Practical SSTO – 12

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

LEO Spacecraft Charging Guidelines – 17

MATERIALS TESTS

Material Outgassing, Identification and Deposition, MOLIDEP System – 52

MATHEMATICAL MODELS

A Generalized Acoustic Analogy – 7

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

Modeling and Simulation for Mission Operations Work System Design – 115

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

Source Term Model for an Array of Vortex Generator Vanes – 50

MATHEMATICAL PROGRAMMING

Collectives for the Optimal Combination of Imperfect Objects – 105

MATRICES (MATHEMATICS)

A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

MEASURING INSTRUMENTS

Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

MECHANICAL ENGINEERING

NASA GSFC Mechanical Engineering Latest Inputs for Verification Standards (GEVS) Updates – 56

The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

MECHANICAL PROPERTIES

Cryogenic Information Center – 34

Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

Status on Mechanical Testing at NASA GSFC – 54

Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

MEDITERRANEAN SEA

A Classification of Mediterranean Cyclones Based on Global Analyses – 85

MEMBRANES

Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

MEMORY (COMPUTERS)

HEASARC Software Archive – 98

MESOSCALE PHENOMENA

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

METAL IONS

Nanostructured Materials Development for Space Power – 36

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

METAL OXIDE SEMICONDUCTORS

Where is scattering important in nanotransistors? – 46

METAL SURFACES

Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

METEOROLOGICAL BALLOONS

Balloon Borne Arc-Second Pointer Feasibility Study – 25

Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

METEOROLOGICAL PARAMETERS

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Monthly Report of the Meteorological Satellite Center: December 2002 – 82

METEOROLOGICAL RADAR

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

METEOROLOGICAL SATELLITES

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

METEOROLOGY

A Classification of Mediterranean Cyclones Based on Global Analyses – 85

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

METHODOLOGY

Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

METROLOGY

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

MICROBALANCES

Material Outgassing, Identification and Deposition, MOLIDEP System – 52

MICROELECTROMECHANICAL SYSTEMS

Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

MICROELECTRONICS

EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

MICROGRAVITY

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

MICROORGANISMS

Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

MICROSATELLITES

Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

MICROSCOPY

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

MICROSTRUCTURE

Catalyzed Ignition of Bipropellants in Microtubes – 29

Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

MICROWAVE ANISOTROPY PROBE

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

MAP Propulsion System Thermal Design – 24

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

MICROWAVE ANTENNAS

K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

MICROWAVE SENSORS

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

MIDDLE ATMOSPHERE

SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

MIE SCATTERING

Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

MILITARY TECHNOLOGY

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

MILKY WAY GALAXY

Chandra Observation of the X-ray Source Population of NGC 6946 – 123

MINIATURIZATION

Timekeeping for the Space Technology 5 (ST-5) Mission – 26

MINORITIES

Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

The Institute on Climate and Planets (ICP): A Research Education Program – 132

MIRRORS

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

MISSION PLANNING

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

Satellite Servicing in Mission Design Studies at the NASA GSFC – 21

The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

MODELS

A Product Development Decision Model for Cockpit Weather Information Systems – 72

An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Living with a Star Space Environment Testbed – 8

The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

Validation of Agent Based Distillation Movement Algorithms – 102

MOISTURE

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Singular Vectors for Moisture-Measuring Norms – 92

MOLECULAR BEAM EPITAXY

High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

MOLECULAR CLOUDS

Interstellar Antifreeze: Ethylene Glycol – 116

MOLECULAR GASES

A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

MOLECULAR SPECTRA

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

MOLECULAR SPECTROSCOPY

High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

MOLECULES

A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

MONKEYS

Neural Dynamics Underlying Event-Related Potentials – 95

MONSOONS

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

MORPHOLOGY

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

MOTION

Space/Time Statistics of Polar Ice Motion – 77

MULTIBEAM ANTENNAS

Multi-Beam Phased Array Antennas – 45

MULTIGRID METHODS

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

MULTIPHASE FLOW

Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

MULTISCALE MODELS

Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

MULTISPECTRAL BAND SCANNERS

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

MULTISPECTRAL RADAR

Calibration Plans for the Global Precipitation Measurement (GPM) – 63

NANOCOMPOSITES

Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

NANOCRYSTALS

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

NANOPARTICLES

Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

NANOSATELLITES

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

NANOSTRUCTURE (CHARACTERISTICS)

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

NANOTECHNOLOGY

Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Where is scattering important in nanotransistors? – 46

NASA PROGRAMS

Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century – 97

Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Satellite Servicing in Mission Design Studies at the NASA GSFC – 21

Systems Engineering Education Development(SEED)Case Study – 113

Visions of our Planet's Atmosphere, Land & Oceans – 91

NASA SPACE PROGRAMS

An Overview of the NASA Sounding Rocket and Balloon Programs – 3

The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

NAVIER-STOKES EQUATION

Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

NAVIGATION

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

Navigation Guidelines for Orbital Formation Flying Missions – 16

NEURAL NETS

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

NEURONS

Neural Dynamics Underlying Event-Related Potentials – 95

NEUTRON STARS

Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

The Complete Z-diagram of LMC X-2 – 117

NEXT GENERATION SPACE TELESCOPE PROJECT

Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

NICKEL ALLOYS

Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

NICKEL ALUMINIDES

Site Occupancy of Ternary Additions to B2 Alloys – 39

NICKEL COMPOUNDS

Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

NICKEL HYDROGEN BATTERIES

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

NiH2 Cycle Life Study – 47

NOAA SATELLITES

Visions of our Planet's Atmosphere, Land & Oceans – 91

NOISE PREDICTION (AIRCRAFT)

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

NOISE REDUCTION

Recent Progress in Engine Noise Reduction Technologies – 107

NOISE (SOUND)

Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

NONDESTRUCTIVE TESTS

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Status on Mechanical Testing at NASA GSFC – 54

NONEQUILIBRIUM THERMODYNAMICS

A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

NONLINEAR EQUATIONS

Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

NONLINEAR SYSTEMS

A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

NONLINEARITY

A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

NONTHERMAL RADIATION

Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

NORTHERN HEMISPHERE

A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

NUCLEAR PROPULSION

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

NUCLEAR REACTIONS

CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

NUCLEAR REACTORS

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

NUCLEATION

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

NUMERICAL ANALYSIS

Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

NUMERICAL FLOW VISUALIZATION

Source Term Model for an Array of Vortex Generator Vanes – 50

OBSERVATION

An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

OBSERVATORIES

Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

OCEAN BOTTOM

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

OCEAN CURRENTS

A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

OCEAN DYNAMICS

MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

OCEAN MODELS

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

OCEAN SURFACE

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

OCEANOGRAPHY

Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

OCEANS

Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

The Sun's Impact on Climate – 73

Visions of our Planet's Atmosphere, Land & Oceans – 91

ONBOARD DATA PROCESSING

Onboard Processor for Compressing HSI Data – 17

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

OPERATING COSTS

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

OPERATING TEMPERATURE

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

OPERATIONAL PROBLEMS

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

OPTICAL EQUIPMENT

Distributed Framework for Dynamic Telescope and Instrument Control – 52

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

OPTICAL FILTERS

Holographic Optical Elements as Scanning Lidar Telescopes – 108

OPTICAL MEASUREMENT

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

OPTICAL PROPERTIES

Effects of Non-Sphericity on Mineral Dust Modeling – 71

OPTICAL RADAR

Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Holographic Optical Elements as Scanning Lidar Telescopes – 108

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

Tropospheric Wind Observations with Doppler Lidars – 74

OPTICAL THICKNESS

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

OPTICAL TRANSITION

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

OPTIMIZATION

Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

OPTOELECTRONIC DEVICES

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

ORBIT DETERMINATION

Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset – 15

JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

ORBITAL MANEUVERS

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

ORBITAL MECHANICS

Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

Navigation Guidelines for Orbital Formation Flying Missions – 16

OSCILLATIONS

Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

OUTGASSING

Material Outgassing, Identification and Deposition, MOLIDEP System – 52

OUTLIERS (STATISTICS)

Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

OXYGEN

Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

OZONE DEPLETION

On the Size of the Antarctic Ozone Hole – 65

OZONE

A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

OZONOMETRY

Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

PACIFIC OCEAN
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

PALLADIUM
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

PARALLEL PROCESSING (COMPUTERS)
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

PARALLEL PROGRAMMING
Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming – 101

PARAMETERIZATION
A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

PARTICLE ACCELERATION
Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

PARTICLE COLLISIONS
Production of Pions in pA-collisions – 112

PARTICLE ENERGY
Two Components in Major Solar Particle Events – 131

PARTICLE MOTION
Effects of Non-Sphericity on Mineral Dust Modeling – 71

PARTICLE SIZE DISTRIBUTION
Effects of Non-Sphericity on Mineral Dust Modeling – 71

PARTICLES
Radiation Requirements and Requirements Flowdown: Single Event Effects (SEEs) and Requirements – 22

PATCH TESTS
Further Developments in the MLPG Method for Beam Problems – 57

PERFORMANCE PREDICTION
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

PERFORMANCE TESTS
Recent Progress in Engine Noise Reduction Technologies – 107

Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

PERIODIC VARIATIONS
On the Size of the Antarctic Ozone Hole – 65

PERIODICALS
EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

Resource Letter GrW-1: Gravitational Waves – 127

PERSONNEL DEVELOPMENT
Systems Engineering Education Development(SEED)Case Study – 113

PERTURBATION
Singular Vectors for Moisture-Measuring Norms – 92

PHASE STABILITY (MATERIALS)
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

PHASE TRANSFORMATIONS
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

PHASED ARRAYS
Multi-Beam Phased Array Antennas – 45

PHOTOGRAMMETRY
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

PHOTOIONIZATION
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

PHOTOLUMINESCENCE
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

PHOTOMETERS
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

PHOTONICS
Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

PHOTOSYNTHESIS
Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

PHOTOVOLTAIC CONVERSION
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

PIEZOELECTRIC ACTUATORS
Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

PIONS
Production of Pions in pA-collisions – 112

PLANETARY BASES
Colonization of Venus – 129

PLANETARY BOUNDARY LAYER
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

PLANETARY MAGNETOSPHERES
Designing Phase 2 for the Double-Lunar Swingby of the Magnetospheric Multiscale Mission (MMS) – 27

PLANETARY ORBITS
Polar Wander on Triton and Pluto Due to Volatile Migration – 129

PLANETARY WAVES
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

PLANETS
A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

PLASMA ACCELERATION
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

PLASMA COMPRESSION
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

PLASMA DYNAMICS
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

PLASMA JETS
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

PLASMA SPRAYING
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

PLASMAS (PHYSICS)
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

PLASTICS
EEE Links, Volume 9, No. 1, January 2003 Focus on Plastic Parts – 47

PLATES (STRUCTURAL MEMBERS)
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

PLATINUM
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

PLUTO (PLANET)
Polar Wander on Triton and Pluto Due to Volatile Migration – 129

POINTING CONTROL SYSTEMS
Balloon Borne Arc-Second Pointer Feasibility Study – 25

Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

POLAR REGIONS
Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores – 122

On the Size of the Antarctic Ozone Hole – 65

Space/Time Statistics of Polar Ice Motion – 77

POLAR WANDERING (GEOLOGY)
Polar Wander on Triton and Pluto Due to Volatile Migration – 129

POLARIZED LIGHT
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

POLLUTION
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

POLYIMIDES
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

POLYMER MATRIX COMPOSITES
Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

POLYMERS
Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

POSEIDON SATELLITE
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

POSITION ERRORS
Relative Navigation of Formation-Flying Satellites – 17

POSITION (LOCATION)
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

POWDER METALLURGY
Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

POWER BEAMING
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

POWER SUPPLIES
Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

PRECIPITATION (METEOROLOGY)
Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

PREDICTIONS
Singular Vectors for Moisture-Measuring Norms – 92

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

PRESSURE DISTRIBUTION
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

PRESSURE OSCILLATIONS
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

PRESSURE RATIO
Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

PRESSURE
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

PROBABILITY THEORY
Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

PROBLEM SOLVING
A Virtual Mission Operations Center - Collaborative Environment – 11

PRODUCT DEVELOPMENT
A Product Development Decision Model for Cockpit Weather Information Systems – 72

Nanostructured Materials Development for Space Power – 36

PRODUCTIVITY
Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

PROGRAM VERIFICATION (COMPUTERS)
Foundations of the Bandera Abstraction Tools – 100

PROGRAMMING (SCHEDULING)
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

PROJECT MANAGEMENT
Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

PROPAGATION (EXTENSION)
Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

PROPAGATION
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

PROPULSION SYSTEM CONFIGURATIONS
MAP Propulsion System Thermal Design – 24

PROPULSION SYSTEM PERFORMANCE
Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

PROPULSION
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

PROTEINS
Redundancies in Large-scale Protein Interaction Networks – 94

PROTOCOL (COMPUTERS)
Internet Technology for Future Space Missions – 15

PROTON ENERGY
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

PROTON RESONANCE
New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

PROVING

Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

PUERTO RICO

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

PULSARS

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

New Pulsars from Arecibo Drift Scan Searches – 118

PULSED PLASMA THRUSTERS

On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

PULTRUSION

An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

PUMPS

Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

PURITY

Nanostructured Materials Development for Space Power – 36

PYROLYSIS

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

QUALITY CONTROL

Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

NASA GSFC Mechanical Engineering Latest Inputs for Verification Standards (GEVS) Updates – 56

QUANTUM DOTS

Nanostructured Materials Development for Space Power – 36

QUANTUM WELLS

Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

QUASARS

Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

RADAR DATA

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

RADAR MEASUREMENT

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

RADIATION BELTS

Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models – 65

RADIATION DAMAGE

Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

RADIATION DOSAGE

Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

RADIATION EFFECTS

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

RADIATION HAZARDS

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

RADIATION TRAPPING

Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models – 65

RADIATIVE TRANSFER

A New Look into the Effect of Large Drops on Radiative Transfer Process – 80

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

RADIO ASTRONOMY

A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

New Pulsars from Arecibo Drift Scan Searches – 118

XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

RADIO COMMUNICATION

Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

RADIO EMISSION

Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

RADIO EQUIPMENT

Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

RADIO OBSERVATION

Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

What can we learn about cosmic structure from gravitational waves? – 120

RADIO OCCULTATION

Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

RAIN GAGES

A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

RAIN

A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

Causes of Long-Term Drought in the USA Great Plains – 86

Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

RAMAN SPECTRA

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

RAMAN SPECTROSCOPY
Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

RAMJET ENGINES
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

RANDOM PROCESSES
Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

RAWINSONDES
Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

RAYLEIGH SCATTERING
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

REAL TIME OPERATION
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

RED SHIFT
A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies – 125

Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

The Intercluster Medium in Clusters – 117

REFLECTANCE
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

REFRACTIVITY
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

RELATIVISTIC PARTICLES
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

RELATIVITY
Resource Letter GrW-1: Gravitational Waves – 127

RELIABILITY ANALYSIS
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

RELIABILITY ENGINEERING
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

REMOTE SENSING
A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Sensor Web and Intelligent Sensors for Earth Science Applications – 60

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

REMOTE SENSORS
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

RESEARCH AND DEVELOPMENT
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

RESEARCH FACILITIES
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

RESIDUAL STRESS
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

RESONANCE
Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

RESOURCES MANAGEMENT
Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

REUSABLE LAUNCH VEHICLES
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

REUSE
Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

REYNOLDS NUMBER
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

RISK
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

RIVER BASINS
Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

ROBUSTNESS (MATHEMATICS)
Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

ROCKET ENGINES
Catalyzed Ignition of Bipropellants in Microtubes – 29

ROCKET-BASED COMBINED-CYCLE ENGINES
Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

ROSAT MISSION
Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

RUNGE-KUTTA METHOD
Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

RUPTURING
Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

RUSSIAN FEDERATION
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

SACCHAROMYCES
Redundancies in Large-scale Protein Interaction Networks – 94

SAFETY
Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

SAPPHIRE
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

SATELLITE ATTITUDE CONTROL
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

SATELLITE COMMUNICATION
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

SATELLITE CONSTELLATIONS
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

Timekeeping for the Space Technology 5 (ST-5) Mission – 26

SATELLITE CONTROL
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

SATELLITE DESIGN
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

SATELLITE GUIDANCE
Satellite GN and C Anomaly Trends – 15

SATELLITE IMAGERY
Monthly Report of the Meteorological Satellite Center: December 2002 – 82

Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

SATELLITE INSTRUMENTS
Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

SATELLITE LASER RANGING
Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

SATELLITE OBSERVATION
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Monthly Report of the Meteorological Satellite Center: December 2002 – 82

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

SATELLITE ORBITS
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

SATELLITE POWER TRANSMISSION
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

SATELLITE SOUNDING
Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Monthly Report of the Meteorological Satellite Center: December 2002 – 82

SATELLITE TRACKING
Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

SATELLITE-BORNE INSTRUMENTS
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

SATELLITE-BORNE RADAR
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

SCALE MODELS
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

Recent Progress in Engine Noise Reduction Technologies – 107

SCATTERING
Where is scattering important in nanotransistors? – 46

SCHOOLS
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

SCIENTIFIC SATELLITES
Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

SEA ICE
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

SEA OF JAPAN
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

SEA SURFACE TEMPERATURE
Causes of Long-Term Drought in the USA Great Plains – 86

SEALS (STOPPERS)
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

SEDIMENTS
Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

SEISMIC ENERGY
The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

SEISMOLOGY
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

SEMICONDUCTOR DEVICES
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

SEMICONDUCTORS (MATERIALS)
Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

SENSITIVITY
Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

SENSORS
Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

Sensor Web and Intelligent Sensors for Earth Science Applications – 60

SENSORY PERCEPTION
Neural Dynamics Underlying Event-Related Potentials – 95

SEPARATED FLOW
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

SEYFERT GALAXIES
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

SHADES
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

SHALLOW WATER
Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

SHAPE OPTIMIZATION
Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

SHAPES
Effective Frequency Technique – 106

Effects of Non-Sphericity on Mineral Dust Modeling – 71

Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

SHEAR STRAIN
Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

SHEAR STRENGTH
Flaw Tolerance in Lap Shear Brazed Joints – 54

Flaw Tolerance In Lap Shear Brazed Joints – 57

SHEAR STRESS
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

SHUTTERS
The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

SIGNAL PROCESSING
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

SIGNAL TO NOISE RATIOS
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

SILICATES
Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

SILICON CARBIDES
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

SILICON DIOXIDE
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

Switching Oxide Traps – 47

SILICON FILMS
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

SILICON NITRIDES
Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

SILICON OXIDES
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

SIMULATION
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

SINGLE CRYSTALS
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

SINGLE EVENT UPSETS
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Radiation Requirements and Requirements Flowdown: Single Event Effects (SEEs) and Requirements – 22

SINGLE STAGE TO ORBIT VEHICLES
High Altitude Launch for a Practical SSTO – 12

SINGULARITY (MATHEMATICS)
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

SIZE DISTRIBUTION
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

SKY SURVEYS (ASTRONOMY)
New Pulsars from Arecibo Drift Scan Searches – 118

SMOKE
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

SNOW COVER
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

SNOWSTORMS
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

SODIUM
Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

SOFTWARE ENGINEERING
Foundations of the Bandera Abstraction Tools – 100

The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

SOI (SEMICONDUCTORS)
High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

SOIL MOISTURE
Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

SOLAR ACTIVITY EFFECTS
Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

SOLAR ACTIVITY
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

SOLAR ARRAYS
High Voltage Space Solar Arrays – 9

LEO Spacecraft Charging Guidelines – 17

Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

SOLAR BACKSCATTER UV SPECTROMETER
Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

SOLAR CORONA
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

SOLAR CORPUSCULAR RADIATION
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Two Components in Major Solar Particle Events – 131

SOLAR CYCLES
Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

SOLAR ECLIPSES
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

SOLAR ELECTRIC PROPULSION
High Voltage Space Solar Arrays – 9

SOLAR FLARES
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Two Components in Major Solar Particle Events – 131

SOLAR GENERATORS
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

SOLAR HEATING
The Sun's Impact on Climate – 73

SOLAR MAGNETIC FIELD
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

SOLAR PHYSICS
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

SOLAR POWER SATELLITES
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

SOLAR POWERED AIRCRAFT
Venus Atmospheric Exploration by Solar Aircraft – 130

SOLAR PROMINENCES
Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

SOLAR PROTONS
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

SOLAR RADIATION SHIELDING
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

SOLAR RADIATION
A New Look into the Effect of Large Drops on Radiative Transfer Process – 80

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

The Sun's Impact on Climate – 73

SOLAR WIND
Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

SOL-GEL PROCESSES
Technology Transfer/Commercialization Report – 113

SOLID PROPELLANT COMBUSTION
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

SOLID PROPELLANTS
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

SOLIDIFICATION
Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

SOLIDS
A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

SOLUTION
Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

SONAR
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

SOS (SEMICONDUCTORS)
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

SOUND GENERATORS
Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

SOUND PROPAGATION
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

SOUNDING ROCKETS
An Overview of the NASA Sounding Rocket and Balloon Programs – 3

SOUTHERN HEMISPHERE
A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

SPACE COLONIES
Colonization of Venus – 129

SPACE COMMUNICATION
Internet Technology for Future Space Missions – 15

SPACE EXPLORATION
Venus Atmospheric Exploration by Solar Aircraft – 130

SPACE FLIGHT
Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

SPACE MISSIONS
A Virtual Mission Operations Center - Collaborative Environment – 11

Benchmark Problems for Space Mission Formation Flying – 54

Internet Technology for Future Space Missions – 15

Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

Modeling and Simulation for Mission Operations Work System Design – 115

Navigation Guidelines for Orbital Formation Flying Missions – 16

The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

Timekeeping for the Space Technology 5 (ST-5) Mission – 26

SPACE NAVIGATION
Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

SPACE OBSERVATIONS (FROM EARTH)
Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

The Complete Z-diagram of LMC X-2 – 117

SPACE PLATFORMS
Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

SPACE PROCESSING
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

SPACE SHUTTLES
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

SPACE TECHNOLOGY EXPERIMENTS
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

SPACE WEATHER

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

SPACEBORNE EXPERIMENTS

Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

LISA Optics Model – 53

On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

SPACEBORNE TELESCOPES

Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

SPACECRAFT ANTENNAS

Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

SPACECRAFT CHARGING

LEO Spacecraft Charging Guidelines – 17

SPACECRAFT CONTROL

A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

SPACECRAFT DESIGN

MAP Propulsion System Thermal Design – 24

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

NASA Thermal Control Technologies for Robotic Spacecraft – 23

Onboard Processor for Compressing HSI Data – 17

SPACECRAFT ELECTRONIC EQUIPMENT

Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

SPACECRAFT GUIDANCE

Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

SPACECRAFT INSTRUMENTS

Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

Spacecraft Angular State Estimation After Sensor Failure – 98

SPACECRAFT LAUNCHING

High Altitude Launch for a Practical SSTO – 12

SPACECRAFT MAINTENANCE

Satellite Servicing in Mission Design Studies at the NASA GSFC – 21

SPACECRAFT PERFORMANCE

Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

SPACECRAFT POWER SUPPLIES

Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

LEO Spacecraft Charging Guidelines – 17

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

SPACECRAFT PROPULSION

Catalyzed Ignition of Bipropellants in Microtubes – 29

SPACECRAFT TEMPERATURE

NASA Thermal Control Technologies for Robotic Spacecraft – 23

Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

SPACECRAFT TRAJECTORIES

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

SPACECREWS

Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

SPATIAL RESOLUTION

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

SPECTRAL REFLECTANCE

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

SPECTRA

A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

SPECTRORADIOMETERS

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

SPECTROSCOPY

Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

SPECTRUM ANALYSIS

A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

Onboard Processor for Compressing HSI Data – 17

SPLINE FUNCTIONS

Further Developments in the MLPG Method for Beam Problems – 57

SPRAYERS

Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

STABILITY

A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

Magnetic Flux Compression Experiments Using Plasma Armatures – 32

STANDARDS
NASA GSFC Mechanical Engineering Latest Inputs for Verification Standards (GEVS) Updates – 56

STAR CLUSTERS
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

STAR FORMATION RATE
Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

STAR FORMATION
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

STAR TRACKERS
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

STARBURST GALAXIES
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

STATE ESTIMATION
Spacecraft Angular State Estimation After Sensor Failure – 98

STELLAR COMPOSITION
The Intercluster Medium in Clusters – 117

STELLAR CORONAS
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

STELLAR EVOLUTION
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

The Intercluster Medium in Clusters – 117

STELLAR OSCILLATIONS
Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

STELLAR SPECTRA
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

The -145 km/s Absorption System of Eta Carinae – 118

STELLAR STRUCTURE
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

STELLAR TEMPERATURE
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

STELLAR WINDS
XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

STIFFNESS
Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

STOCHASTIC PROCESSES
Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

STRATOSPHERE
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Balloon Borne Arc-Second Pointer Feasibility Study – 25

Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

STRESS MEASUREMENT
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

STRESS RELAXATION
Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

STRESSES
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

STRING THEORY
Production of Pions in pA-collisions – 112

STRUCTURAL ANALYSIS
Status on Mechanical Testing at NASA GSFC – 54

STRUCTURAL DESIGN
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

STRUCTURAL FAILURE
Flaw Tolerance In Lap Shear Brazed Joints – 57

STRUCTURAL WEIGHT
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

STRUCTURED GRIDS (MATHEMATICS)
Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

STUDENTS
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

Science Through ARts (STAR) – 112

The Institute on Climate and Planets (ICP): A Research Education Program – 132

SUBMILLIMETER WAVES
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

SULFUR
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

SUN
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

SUPERGIANT STARS
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

SUPERMASSIVE STARS
The -145 km/s Absorption System of Eta Carinae – 118

What can we learn about cosmic structure from gravitational waves? – 120

SUPERNOVA REMNANTS
Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

SUPERSONIC JET FLOW
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

SURFACE CRACKS
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

SURFACE ENERGY
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

SURFACE PROPERTIES
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

NASA Thermal Control Technologies for Robotic Spacecraft – 23

SUSPENDING (MIXING)

A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

SWINGBY TECHNIQUE

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

SWITCHING

Switching Oxide Traps – 47

SYMMETRY

The Anharmonic Force Field of BeH2 Revisited – 110

SYNTHESIS (CHEMISTRY)

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

SYSTEMS ANALYSIS

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

SYSTEMS ENGINEERING

A Virtual Mission Operations Center - Collaborative Environment – 11

Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Human Centered Design and Development for NASA's MerBoard – 100

Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

MAP Propulsion System Thermal Design – 24

Modeling and Simulation for Mission Operations Work System Design – 115

Multi-Beam Phased Array Antennas – 45

Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

Systems Engineering Education Development(SEED)Case Study – 113

The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

SYSTEMS HEALTH MONITORING

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

SYSTEMS INTEGRATION

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

TEAMS

Implicit Communication in Novice and Expert Teams – 95

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

TECHNOLOGY ASSESSMENT

Chapman-1024 Processor Shared Memory – 100

Recent Progress in Engine Noise Reduction Technologies – 107

TECHNOLOGY TRANSFER

Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century – 97

Technology Transfer/Commercialization Report – 113

TECHNOLOGY UTILIZATION

High Voltage Space Solar Arrays – 9

Nanostructured Materials Development for Space Power – 36

Technology Transfer/Commercialization Report – 113

Timekeeping for the Space Technology 5 (ST-5) Mission – 26

TELECOMMUNICATION

A Virtual Mission Operations Center - Collaborative Environment – 11

TELESCOPES

Distributed Framework for Dynamic Telescope and Instrument Control – 52

Holographic Optical Elements as Scanning Lidar Telescopes – 108

Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

TEMPERATE REGIONS

Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Climate Controls on Carbon Sequestration in Eastern North America – 92

TEMPERATURE CONTROL

Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

NASA Thermal Control Technologies for Robotic Spacecraft – 23

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

TEMPERATURE DEPENDENCE

Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

TEMPERATURE EFFECTS

Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

TEMPERATURE GRADIENTS

A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

TEMPERATURE MEASUREMENT

Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 132

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

TEMPERATURE

Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

TEMPORAL DISTRIBUTION

Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

TENSILE STRENGTH

Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

TENSILE STRESS

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

TERNARY ALLOYS

Site Occupancy of Ternary Additions to B2 Alloys – 39

TERRESTRIAL RADIATION

Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models – 65

TEST FACILITIES

Recent Enhancements to the National Transonic Facility – 9

Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

TEST STANDS

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

TESTS

An Integrated Analysis-Test Approach – 102

TEXTURES

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

THEMATIC MAPPING

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

THERMAL ANALYSIS

MAP Propulsion System Thermal Design – 24

THERMAL CONDUCTIVITY

The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

THERMAL CONTROL COATINGS

Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

THERMAL VACUUM TESTS

MAP Propulsion System Thermal Design – 24

Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

THERMISTORS

Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

THERMODYNAMIC PROPERTIES

Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

THERMODYNAMICS

A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

THERMOPHYSICAL PROPERTIES

Cryogenic Information Center – 34

THERMOSTATS

NASA Thermal Control Technologies for Robotic Spacecraft – 23

THIN FILMS

Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

THIN PLATES

Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

THIOLS

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

THREE BODY PROBLEM

A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

THREE DIMENSIONAL FLOW

Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

THREE DIMENSIONAL MODELS

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

THRUST AUGMENTATION

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

THRUST MEASUREMENT

Development of a Thrust Stand to Meet LISA Mission Requirements – 29

THRUST

Development of a Thrust Stand to Meet LISA Mission Requirements – 29

TIME DEPENDENCE

An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

TIME MEASUREMENT

Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

TIME SERIES ANALYSIS

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Space/Time Statistics of Polar Ice Motion – 77

The Goddard VLBI SINEX Files – 101

TIN ALLOYS

Directional Solidification and Convection in Small Diameter Crucibles – 41

TOPOGRAPHY

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

TOTAL OZONE MAPPING SPECTROMETER

Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

TOWERS

High Altitude Launch for a Practical SSTO – 12

TRACE CONTAMINANTS

A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

TRACKING (POSITION)

Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset – 15

TRAILING EDGES

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

TRAINING ANALYSIS

Implicit Communication in Novice and Expert Teams – 95

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

TRAJECTORY ANALYSIS

Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

High Altitude Launch for a Practical SSTO – 12

TRAJECTORY CONTROL

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

TRAJECTORY OPTIMIZATION

A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

TRAJECTORY PLANNING

Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

TRANSFORMERS

Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

TRANSMISSION ELECTRON MICROSCOPY

Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

TRANSONIC SPEED

Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

TRANSONIC WIND TUNNELS

Recent Enhancements to the National Transonic Facility – 9

TRANSPIRATION

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

TRANSPORT PROPERTIES

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

TRAPPING

Switching Oxide Traps – 47

TREND ANALYSIS

Satellite GN and C Anomaly Trends – 15

TRENDS

Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

TRITON

Polar Wander on Triton and Pluto Due to Volatile Migration – 129

TRMM SATELLITE

Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

TROPICAL REGIONS

Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

TROPICAL STORMS

Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

TROPOPAUSE

A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

TROPOSPHERE

A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Tropospheric Wind Observations with Doppler Lidars – 74

TURBINES

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

TURBULENCE MODELS

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

TURBULENCE

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

TURBULENT BOUNDARY LAYER

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

TURBULENT FLOW

Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

TWO DIMENSIONAL MODELS

Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

TYPE 3 BURSTS
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

ULTRAVIOLET ABSORPTION
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

ULTRAVIOLET DETECTORS
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

ULTRAVIOLET EMISSION
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

ULTRAVIOLET RADIATION
Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

ULTRAVIOLET SPECTRA
Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

ULTRAVIOLET SPECTROSCOPY
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

UNDERWATER ACOUSTICS
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

UNIVERSITIES
Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

The Institute on Climate and Planets (ICP): A Research Education Program – 132

UNMANNED SPACECRAFT
NASA Thermal Control Technologies for Robotic Spacecraft – 23

Satellite GN and C Anomaly Trends – 15

UNSTEADY AERODYNAMICS
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

UNSTRUCTURED GRIDS (MATHEMATICS)
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

URBAN DEVELOPMENT
A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

VACUUM CHAMBERS
Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

VACUUM
Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

VAPOR DEPOSITION
Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

VAPORIZING
Alumina Volatility in Water Vapor at Elevated Temperatures – 40

VARIABLE STARS
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

VARIATIONS
The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

VECTORS (MATHEMATICS)
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

VEGETATION GROWTH
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

VEGETATION
Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

VENUS ATMOSPHERE
Colonization of Venus – 129

Venus Atmospheric Exploration by Solar Aircraft – 130

VENUS (PLANET)
Colonization of Venus – 129

VERBAL COMMUNICATION
Implicit Communication in Novice and Expert Teams – 95

VERTICAL AIR CURRENTS
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

VERTICAL DISTRIBUTION
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

VERY LARGE ARRAY (VLA)
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

VERY LONG BASE INTERFEROMETRY
The Goddard VLBI SINEX Files – 101

VIBRATION TESTS
Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

VIBRATION
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

VIDEO COMMUNICATION
Visions of our Planet's Atmosphere, Land & Oceans – 91

VISCOELASTICITY
A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

VISCOPLASTICITY
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

VOLATILITY
Alumina Volatility in Water Vapor at Elevated Temperatures – 40

Polar Wander on Triton and Pluto Due to Volatile Migration – 129

VOLCANOLOGY
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

VORTEX GENERATORS
Source Term Model for an Array of Vortex Generator Vanes – 50

VORTICES
Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

VORTICITY
Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

VULNERABILITY
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

WAFERS
Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

WAR GAMES
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

WATER BALANCE
Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

WATER RESOURCES
Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

WATER VAPOR
Alumina Volatility in Water Vapor at Elevated Temperatures – 40

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

WATER
Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

WAVE PROPAGATION
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

WAVEGUIDES
Multi-Beam Phased Array Antennas – 45

Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

WEATHER FORECASTING
Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

WEATHER
NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

WEIGHTING FUNCTIONS
Further Developments in the MLPG Method for Beam Problems – 57

WETLANDS
Climate Controls on Carbon Sequestration in Eastern North America – 92

WHALES
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

WHITE DWARF STARS
The Origin of Soft X-rays in DQ Herculis – 122

WIND DIRECTION
Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

WIND MEASUREMENT
Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

Tropospheric Wind Observations with Doppler Lidars – 74

WIND (METEOROLOGY)
A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

WIND TUNNEL TESTS
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

Recent Enhancements to the National Transonic Facility – 9

Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

WIND TUNNELS
Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

WIND VELOCITY
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

WINGS
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

WINTER
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

WOLF-RAYET STARS
XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

WORKLOADS (PSYCHOPHYSIOLOGY)
The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

WOVEN COMPOSITES
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

X RAY ABSORPTION
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

X RAY ANALYSIS
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

X RAY ASTRONOMY
An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay – 119

The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

X RAY ASTROPHYSICS FACILITY
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Chandra Observation of the X-ray Source Population of NGC 6946 – 123

The Origin of Soft X-rays in DQ Herculis – 122

X RAY BINARIES
An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

The Complete Z-diagram of LMC X-2 – 117

The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

X RAY DIFFRACTION

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

X RAY IMAGERY

Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

X RAY SOURCES

Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

The Origin of Soft X-rays in DQ Herculis – 122

X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

X RAY SPECTRA

A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies – 125

Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

X RAY SPECTROSCOPY

A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

X RAY STARS

Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

X RAY TIMING EXPLORER

Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

The Complete Z-diagram of LMC X-2 – 117

X RAYS

Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

XMM-NEWTON TELESCOPE

An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

YTTRIA-STABILIZED ZIRCONIA

Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

ZIRCONIUM OXIDES

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Personal Author Index

Abdalla, Mohamed O.
Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

Abe, K.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Abel, Phillip B.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Abel, Phillip
Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Aburdene, Maurice F.
Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming – 101

Ackerman, Steven A.
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Adams, W. J.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Adler, Robert F.
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Agarwal, A.
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Ahmad, Suraiya P.
Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Ahmad, Z.
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Ahn, C.
Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Allamandola, Louis J.
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

Allison, Dennis O.
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

Alter, Stephen J.
Efficient Development of High Fidelity Structured Volume Grids for Hypersonic Flow Simulations – 105

Alterovitz, S. A.
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Amador, Carlos
Site Occupancy of Ternary Additions to B2 Alloys – 39

Ames, Troy J.
Distributed Framework for Dynamic Telescope and Instrument Control – 52

Anantram, M. P.
Where is scattering important in nanotransistors? – 46

Andary, James
Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

Angelini, Lorella
An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

Anraku, K.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Ao, Chi On
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

Ardizzone, Joe
Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Argade, Shyam
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

Armantrout, Jon D.
NiH2 Cycle Life Study – 47

Arnold, Steven M.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

Arzoumanian, Z.
New Pulsars from Arecibo Drift Scan Searches – 118

Asaoka, Y.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Ashpis, David E.
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

Asoka, Y.
Progress in Search for Antihelium with BESS – 66

Atlas, R.
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Atlas, Robert M.
Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Atlas, Robert
A Classification of Mediterranean Cyclones Based on Global Analyses – 85

Large 0/12 GMT Differences of US Vaisala RS80 Observations – 84

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Backer, D. C.
New Pulsars from Arecibo Drift Scan Searches – 118

Bagg, Thomas C., III
Systems Engineering Education Development(SEED)Case Study – 113

Bailey, Sheila G.
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Nanostructured Materials Development for Space Power – 36

Bailey, Sheila
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

Balagadde, Frederick
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

Balakrishna, S.
Recent Enhancements to the National Transonic Facility – 9

Baldauff, Robert
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Baldy, Serge
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Band, David L.
Comparison of the Gamma-Ray Burst Sensitivity of Different Detectors – 123

Bandara, S.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Banger, Kulbinder K.
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

Banks, S.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Baray, Jean-Luc
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Bardina, Jorge
Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

Barltzhack, Itzhack Y.
Spacecraft Angular State Estimation After Sensor Failure – 98

Barrett, Charles A.
Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Barszcz, Eric
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Bartels, Robert E.
A Time Integration Algorithm Based on the State Transition Matrix for Structures with Time Varying and Nonlinear Properties – 104

Barth, Janet L.
Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Models Required to Mitigate Impacts of Space Weather on Space Systems – 22

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

Barth, Janet
Living with a Star Space Environment Testbed – 8

Bauer, Frank H.
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

Bauer, Frank
A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

Spacecraft Angular State Estimation After Sensor Failure – 98

Baumgart, Rudolf
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

Bautista, M. A.
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

Bay, Stephen D.
Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

Bayr, Klaus J.
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Bebout, Brad M.
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Becker, C. R.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Beckman, Mark
Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

Bedard, Donald
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Beheim, Glenn M.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Bell, Thomas L.
Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

Benavage, Emye L.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Benavage, Emye
Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Benson, Scott
On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

Berkebile, Steven
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

Berry, Matthew M.
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Berry, Matthew
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Bertilone, Derek
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

Bhartia, P. K.
Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Bidwell, S. W.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Bindschadler, Robert A.
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Bings, John P.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Birur, Gajanana C.
NASA Thermal Control Technologies for Robotic Spacecraft – 23

Blair, J. Bryan
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Block, Nathan F.
Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

Bobbitt, C. W.
Recent Enhancements to the National Transonic Facility – 9

Bolvin, David
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Bond, Ryan B.
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

Bowles, Kenneth J.
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Boyarko, George A.
Catalyzed Ignition of Bipropellants in Microtubes – 29

Boyd, Patricia T.
The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

Bozzolo, G.
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Bozzolo, Guillermo H.
Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

Site Occupancy of Ternary Additions to B2 Alloys – 39

Bozzolo, Guillermo
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

Brackett, V. G.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Braun, Scott A.
Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

Breen, Daniel P.
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Bressler, Steven L.
Neural Dynamics Underlying Event-Related Potentials – 95

Brewer, Dana A.
Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

Bristow, John
NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Brook, Edward
Accretion of Interplanetary Dust: A New Record from He-3 In Polar Ice Cores – 122

Brown, Deborah A.
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Brown, J. David
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

Brumfield, Mark D.
Systems Engineering Education Development(SEED)Case Study – 113

Buchko, Matthew T.
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

Buchner, Stephen P.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Buning, P. G.
Source Term Model for an Array of Vortex Generator Vanes – 50

Burns, Richard
Benchmark Problems for Space Mission Formation Flying – 54

Bussman, Marie
A Virtual Mission Operations Center - Collaborative Environment – 11

Butler, Dan
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Cahalan, Robert
The Sun's Impact on Climate – 73

Calomino, Anthony
Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

Campbell, Sandi
Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

Cane, H. V.
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

Two Components in Major Solar Particle Events – 131

Cardiff, Eric H.
Inconsistent Definitions of the Pressure-Coupled Response and the Admittance of Solid Propellants – 43

Cardinali, Carla
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

Carlson, Barbara
The Institute on Climate and Planets (ICP): A Research Education Program – 132

Carpenter, J. Russell
Benchmark Problems for Space Mission Formation Flying – 54

Navigation Guidelines for Orbital Formation Flying Missions – 16

Relative Navigation of Formation-Flying Satellites – 17

Carpenter, Mark H.
Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

Carpenter, Russell
GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Carpenter, Steven
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Carstens, Deborah S.
Task Analysis Technologies at KSC – 113

Carts, Martin A.
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Casasanta, Ralph
Internet Technology for Future Space Missions – 15

Case, Lynne
Distributed Framework for Dynamic Telescope and Instrument Control – 52

Casey, Carolyn A.
Systems Engineering Education Development(SEED)Case Study – 113

Castro, S. L.
Nanostructured Materials Development for Space Power – 36

Castro, Stephanie L.
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Cavallo, Peter A.
Static Aeroelastic Predictions for a Transonic Transport Model Using an Unstructured-Grid Flow Solver Coupled With a Structural Plate Technique – 3

Centrella, Joan M.
Resource Letter GrW-1: Gravitational Waves – 127

What can we learn about cosmic structure from gravitational waves? – 120

Centrella, Joan
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

Chambers, Joseph R.
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

Chambers, V. John
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Champion, J. L.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Chan, C. Y.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Chandra, S.
Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Chang, W. L.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Chao, B. F.
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

Chao, Benjamin F.
The Global Geophysical Fluids Center of IERS (and its Special Bureau for Mantle) – 71

Time-Variable Gravity from Space: Quarter Century of Observations, Mysteries, and Prospects – 69

Chapman, J. N.
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Chapman, Taryn
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Chen, J.
Directional Solidification and Convection in Small Diameter Crucibles – 41

Chen, Liang-Yu
High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Cheng, Victore H. L.
Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

Cheung, Kwok
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Chien, Janet Y. L.
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Chillier, Xavier D. F.
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

Chin, M.
Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

Chin, Mian
MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Chinn, D. S.
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Cho, J.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Cho, K. K.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Choi, Dae-Il
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

Chou, Shu-Hsien
Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Choudhuri, Ahsan
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Choudhury, Bhaskar J.
Estimating Net Primary Productivity Using Satellite and Ancillary Data – 59

Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

Christodoulou, Dimitris M.
Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

Chu, D. Allen
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Chu, W.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Ciotii, Robert
Chapman-1024 Processor Shared Memory – 100

Cisewski, M.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Clancey, William J.
Agent Interaction with Human Systems in Complex Environments: Requirements for Automating the Function of CapCom in Apollo 17 – 96

Modeling and Simulation for Mission Operations Work System Design – 115

Cleveland, Paul E.
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

Cline, T. L.
Strategies for Studying the Sources of Gamma Ray Bursts – 118

Coetzee, Gert J. R.
Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

Cohen, C. M. S.
Two Components in Major Solar Particle Events – 131

Colaiuta, J. F.
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Cole, J. W.
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Colozza, A.
Venus Atmospheric Exploration by Solar Aircraft – 130

Conley, Carolynn L.
Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

Conley, Carolynn Lee
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Connelly, Joseph A.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Contopoulos, John
Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

Cook, Sid
Onboard Processor for Compressing HSI Data – 17

Corcoran, M. F.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Cordes, J. M.
New Pulsars from Arecibo Drift Scan Searches – 118

Cordes, Joseph
Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

Coudert, L. H.
Interstellar Antifreeze: Ethylene Glycol – 116

Coughlan, Joseph C.
The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

Coy, L.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Croke, E. T.
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

Crutzen, P. J.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Cuevas, Osvaldo O.
Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

Curtis, Scott
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Cutler, A. D.
Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

Dailey, Christopher
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

Danehy, P. M.
Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

Danks, A.
Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

The -145 km/s Absorption System of Eta Carinae – 118

Danks, Anthony
Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

Darrin, A. G.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

DaSilva, A. M.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Davis, Curtiss O.
Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Davis, Gary T.
The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

Davis, George
GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Day, John H.
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Onboard Processor for Compressing HSI Data – 17

Dean, Derrick
Viscoelastic and Mechanical Properties of Thermoset PMR-type Polyimide-Clay Nanocomposites – 33

DeGroh, H. C., III
Directional Solidification and Convection in Small Diameter Crucibles – 41

deGroh, H. C.
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

delaTorreJuarez, Manuel
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

DeLaurentis, Dan
Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

Dell, Greg
NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

DeLoach, R.
Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

Delory, Greg
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

DeMange, Jeffrey J.
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Demarco, Gustavo
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

Demoz, Belay
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Denis, Vincent
High Altitude Launch for a Practical SSTO – 12

Dennehy, C. J.
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

DesMarais, David J.
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Devenport, William J.
Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

DeWeese, Keith D.
Balloon Borne Arc-Second Pointer Feasibility Study – 25

DiCarlo, James A.
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

DiGirolamo, Paolo
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Ding, Ming-Zhou
Neural Dynamics Underlying Event-Related Potentials – 95

Discipulo, Mykell
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Donnelly, Michael
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

Dorband, John E.
Architecture-Adaptive Computing Environment: A Tool for Teaching Parallel Programming – 101

Dorrington, A. A.
Response Surface Methods For Spatially-Resolved Optical Measurement Techniques – 109

dosSantos, J.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Douglas, Donya
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Douglass, A. R.
A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

Douglass, Anne R.
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Downey, A. N.
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Dudley, Michael
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Dunlap, Patrick H., Jr.
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Dupree, Andrea K.
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

Duraj, Stan A.
Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

Duvet, Ludovic
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Dworkin, Jason P.
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

Dwyer, Matthew B.
Foundations of the Bandera Abstraction Tools – 100

Eberspeaker, Philip J.
An Overview of the NASA Sounding Rocket and Balloon Programs – 3

Ebinuma, T.
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Edery, Ariel
Designing Phase 2 for the Double-Lunar Swingby of the Magnetospheric Multiscale Mission (MMS) – 27

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

Edwards, Bernard L.
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

Edwards, Jack R.
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

Ehrendorfer, Martin
Singular Vectors for Moisture-Measuring Norms – 92

Eichhorn, G.
US Astronomers Access to SIMBAD in Strasbourg, France – 114

Eldridge, J. I.
Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Elich, J. B.
Nanostructured Materials Development for Space Power – 36

Elvis, Martin
Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

Emery, William J.
Space/Time Statistics of Polar Ice Motion – 77

Envia, E.
Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

Envia, Edmane
Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

Erickson, W. C.
Energetic Particle Propagation in the Inner Heliosphere as Deduced from Low Frequency (less than 100 kHz) Observations of Type III Radio Bursts – 120

Ericsson, Aprille Joy
Guidance, Navigation and Control Innovations at the NASA Goddard Space Flight Center – 24

Errico, Ronald M.
Singular Vectors for Moisture-Measuring Norms – 92

Esper, Jaime
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Esposito, Timothy C.
Multiple Autonomous Discrete Event Controllers for Constellations – 14

Evans, Keith
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Everett, D. F.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Fanwic, Phillp E.
Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

Farrar, D.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Feenan, David
Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

Ferguson, D. C.
High Voltage Space Solar Arrays – 9

LEO Spacecraft Charging Guidelines – 17

Fesmire, James E.
Cryogenic Information Center – 34

Filman, Robert
The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

Fitz-Coy, Norman
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

Flaming, G. M.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Fleming, Eric
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Flittner, David
Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Flom, Yury
Flaw Tolerance in Lap Shear Brazed Joints – 54

Flaw Tolerance In Lap Shear Brazed Joints – 57

Folta, D. C.
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Folta, David C.
Benchmark Problems for Space Mission Formation Flying – 54

Folta, David
Formation Flying Design and Applications in Weak Stability Boundary Regions – 21

Libration Orbit Mission Design: Applications of Numerical & Dynamical Methods – 19

NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

Fortuin, J. P. F.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Fowler, Charles
Space/Time Statistics of Polar Ice Motion – 77

Fraser, K. F.
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

Frawley, James J.
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Freed, Alan
A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

Freeman, J. C.
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Freiman, M. Tai
Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

Fruchter, A.
New Pulsars from Arecibo Drift Scan Searches – 118

Frumkin, Michael A.
Arithmetic Data Cube as a Data Intensive Benchmark – 103

Fujikawa, M.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Fujimoto, T.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Fuke, H.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Furano, Gianluca
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Furrer, David
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Fusilier, Fred C.
Cryogenic Information Center – 34

Gabb, Tim
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Gabb, Timothy
Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Gaier, James R.
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

Galofaro, J. T.
High Voltage Space Solar Arrays – 9

Gambles, J.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Gao, Bo-Cai
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Garces, Jorge E.
Growth of Pt/Cu(100): An Atomistic Modeling Comparison with the Pd/Cu(100) Surface Alloy – 39

Gasper, James L.
Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

Gates, Thomas S.
Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

Gayda, John
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Gee, George
In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Geller, Marvin
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Gelman, Mel
The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Gennett, T.
Nanostructured Materials Development for Space Power – 36

Gentry, Bruce
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Georganopoulos, M.
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

George, Ian M.
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

Gervin, Jan
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Ghosn, L. J.
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Gill, Andrew W.
Validation of Agent Based Distillation Movement Algorithms – 102

Gill, E.
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Ginoux, Paul
Effects of Non-Sphericity on Mineral Dust Modeling – 71

Ginoux, P.
Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

Gleason, James
Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Gliebe, Philip
Recent Progress in Engine Noise Reduction Technologies – 107

Godfrey, Sara
Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

Golden, Keith
Automating the Processing of Earth Observation Data – 66

Goldstein, M. E.
A Generalized Acoustic Analogy – 7

Goldstein, Marvin E.
Sound Generation in the Presence of Moving Surfaces with Application to Internally Generated Aircraft Engine Noise – 5

Golliher, Eric
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Graham, Steven M.
A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Grambling, Cheryl
Relative Navigation of Formation-Flying Satellites – 17

Granata, Raymond L.
Systems Engineering Education Development(SEED)Case Study – 113

Gray, Mark A.
Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Greenhouse, Matthew A.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Gregg, Watson
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Grieger, Dion
Validation of Agent Based Distillation Movement Algorithms – 102

Gross, R. S.
Co-Seismic Mass Dislocation and its Effect on Earth's Rotation and Gravity – 69

Grosvenor, Sandy
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

Gudima, K. K.
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Gudipati, Murthy S.
Luminescence from Vacuum-Ultraviolet-Irradiated Cosmic Ice Analogs and Residue – 130

Guerra, David V.
Holographic Optical Elements as Scanning Lidar Telescopes – 108

Guilderson, T.
Climate Controls on Carbon Sequestration in Eastern North America – 92

Gull, T. R.
Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

Gull, Theodore R.
The -145 km/s Absorption System of Eta Carinae – 118

Gull, Theodore
Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

Gunapala, S.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Gupta, Surabhi
A Product Development Decision Model for Cockpit Weather Information Systems – 72

Gutro, Rob
NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Guzman, J. J.
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Guzman, Jose J.
A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

Flying a Four-Spacecraft Formation by the Moon...Twice – 11

Habib, Shahid
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Sensor Web and Intelligent Sensors for Earth Science Applications – 60

Haggerty, D. K.
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Haino, S.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Hale, Kathleen L.
The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

Hall, Christopher D.
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Hall, Christopher
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Hall, Dorothy K.
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Hall, Forrest
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Hall, Robert M.
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

Halverson, Jeff
NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Hamann, Fred
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

Hamilton, Kevin
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Hams, T.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Harding, Alice K.
Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

Harman, Richard R.
Spacecraft Angular State Estimation After Sensor Failure – 98

Harris, Andrew I.
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

Harris, J. M.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Harris, Jerry D.
The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

Harris, Patrick K.
Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup – 28

Harsanyi, Joe
Onboard Processor for Compressing HSI Data – 17

Hartwell, J. M.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Hasler, Arthur F.
Visions of our Planet's Atmosphere, Land & Oceans – 91

Hass, J.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Hatcliff, John
Foundations of the Bandera Abstraction Tools – 100

Havelund, Klaus
The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

Hawk, C. W.
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

Hawkins, Albin
NASA's Autonomous Formation Flying Technology Demonstration, Earth Observing-1(EO-1) – 18

Results Of NASA's First Autonomous Formation Flying Experiment: Earth Observing-1 (EO-1) – 27

Heaps, William S.
Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

Hellier, C.
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

Hennessy, Joseph F.
Internet Technology for Future Space Missions – 15

Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft – 8

Hepp, Aloysius F.
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Nanostructured Materials Development for Space Power – 36

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

Hepp, Aloysius
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

Herman, J. R.
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Herman, Jay R.
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Herman, Jay
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Herring, David
NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Higgins, R. Wayne
Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Hillard, G. B.
High Voltage Space Solar Arrays – 9

LEO Spacecraft Charging Guidelines – 17

Hinkle, R. Kenneth
Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

Hinkley, Jeffrey A.
Computational Materials: Modeling and Simulation of Nanostructured Materials and Systems – 36

Hoang, Triem
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Hoff, Raymond
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

Hofton, M.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Hogie, Keith
Internet Technology for Future Space Missions – 15

Hoist, Terry L.
Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

Holben, Brent N.
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Hollandsworth, Roger P.
NiH2 Cycle Life Study – 47

Hollis, J. M.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Interstellar Antifreeze: Ethylene Glycol – 116

Holt, S. S.
Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Homan, J.
The Complete Z-diagram of LMC X-2 – 117

Horne, William D.
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

Hoskins, Andrew
On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

Hou, Arthur
Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Houghton, M. B.
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Houghton, R.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Howard, James W., Jr.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Howard, James W.
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Howe, J. M.
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Hsu, Christina N.
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Hsu, N. Christina
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Hubanks, Paul A.
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Huff, Dennis
Recent Progress in Engine Noise Reduction Technologies – 107

Huff, Edward M.
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Huffman, George
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Hughes, S. P.
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Hughes, Steven P.
A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

Hultgren, Lennart S.
Demonstration of Separation Control Using Glow-Discharge Plasma Actuators – 50

Glow Discharge Plasma Active Control of Separation at Low Pressure Turbine Conditions – 50

Hurley, K. C.
Strategies for Studying the Sources of Gamma Ray Bursts – 118

Hussey, Sam W.
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

Hwang, T.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Hwang, U.
Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Hyde, T. Tupper
Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

Hy-Young, Kim
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Iacovazzi, Robert A., Jr.
Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

Ibrahim, Alaa I.
New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

Ichoku, Charles
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Ikeda, N.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Imbiriba, Breno
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

Imori, M.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Progress in Search for Antihelium with BESS – 66

Inoue, M.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Isaak, Kate G.
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

Iyer, Saiganesh K.
Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

Jackman, Charles H.
Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Jackson, George
Timekeeping for the Space Technology 5 (ST-5) Mission – 26

Jackson, Michael L.
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Jamison, Donald E.
Systems Engineering Education Development(SEED)Case Study – 113

Jannuzi, Buell T.
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

Jenkins, Gregory S.
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Jewell, P. R.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Interstellar Antifreeze: Ethylene Glycol – 116

Jhabvala, M.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Ji, Q. Jack
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Jin, Michael H.-C.
The Effect of Film Composition on the Texture and Grain Size of CuInS2 Prepared by Spray Pyrolysis – 32

Johansson, S.
Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

The -145 km/s Absorption System of Eta Carinae – 118

Johnson, B. J.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Johnson, Chris
Power Control and Monitoring Requirements for Thermal Vacuum/Thermal Balance Testing of the MAP Observatory – 28

Johnson, D.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Johnson, James E.
Atmospheric products from the Upper Atmosphere Research Satellite (UARS) – 71

Johnston, John
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

Johnston, Shaida
Public Good or Commercial Opportunity: Case Studies in Remote Sensing Commercialization – 60

Joiner, J.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Joiner, Joanna
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Jones, F. C.
Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

Jones, Jeremy
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

Jusem, J. C.
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Kachroo, Pushkin
A Product Development Decision Model for Cockpit Weather Information Systems – 72

Kahn, S. M.
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

Kalia, Rajiv K.
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Kallman, T. R.
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

Kalluri, Sreeramesh
Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

Kamotani, Y.
Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

Kamvouris, John
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Kandula, Max
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

Kantzos, Pete
Low Cost Heat Treatment Process for Production of Dual Microstructure Superalloy Disks – 39

Kantzos, Peter
Mechanical Properties of a Superalloy Disk With a Dual Grain Structure – 41

Kardos, Monique
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Karoly, David
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Karpati, Gabriel
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

Kato, Teryuki
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Kauffmann, Paul
A Product Development Decision Model for Cockpit Weather Information Systems – 72

Kaufman, Daniel
An Integrated Analysis-Test Approach – 102

NASA GSFC Mechanical Engineering Latest Inputs for Verification Standards (GEVS) Updates – 56

Status on Mechanical Testing at NASA GSFC – 54

Kaufman, Yoram J.
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Kaufman, Yoram
MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Kawa, S. Randolph
On the Size of the Antarctic Ozone Hole – 65

Progress on Passive Sensor for Ultra-Precise Measurement of Carbon Dioxide from Space – 89

Kazanas, D.
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

Kazanas, Demosthenes
Interchange Method in Compressible Magnetized Couette Flow: Magnetorotational and Magnetoconvective Instabilities – 122

Keckhut, Philippe
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Kelbel, David
Relative Navigation of Formation-Flying Satellites – 17

Kelder, H. M.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Kelkar, Ajit
Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

Kennedy, Christopher A.
Additive Runge-Kutta Schemes for Convection-Diffusion-Reaction Equations – 104

Kenny, Thomas
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

Keohane, J. W.
Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

Khain, A.
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Khairoutdinov, M.
Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

Khalil, Joseph
Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

Khodaparast, G. A.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Kikuchi, Hideaki
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Kilgore, W. A.
Recent Enhancements to the National Transonic Facility – 9

Killeen, Damien
Sperm Whale Impulse Noise and Incoherent Narrowband CFAR Processing – 107

Kim, Hye-Young
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Kim, Hyung Rae
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

Kim, Jeong Woo
Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

Kim, Jungho
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

King, Michael D.
A Perspective of Our Planet's Atmosphere, Land, and Oceans: A View from Space – 52

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

King, Terry
Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

Kinkhabwala, A.
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

Kirby, Michelle R.
Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

Kirchman, Frank
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Kirk, C. Laurence
Effective Frequency Technique – 106

Klein, Andrew G.
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Kniffin, Scott D.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Knox, Robert
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Knuteson, R.
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Knuth, Kevin H.
Intelligent Machines in the 21st Century: Automating the Processes of Inference and Inquiry – 103

Neural Dynamics Underlying Event-Related Potentials – 95

Kolecki, Joseph
Science Through ARts (STAR) – 112

Koloklov, K.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Kolokolov, Kanstantin I.
Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

Kolokolov, Konstantin I.
Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

Kono, J.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Koratkar, Anuradha
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

Korsmeyer, David
The Effect of AOP on Software Engineering, with Particular Attention to OIF and Event Quantification – 100

Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

Koster, Randal D.
Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Koster, Randal
Causes of Long-Term Drought in the USA Great Plains – 86

Krizmanic, J.
Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Krol, M. C.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Krol, Stanley J., Jr.
Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

Krotkov, N.
Properties of Backscattered Ultraviolet Reflectances in Cloudy Atmosphere – 93

Ku, Jentung
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

Kucera, T.
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Kummerow, Christian
Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Kumta, Prashant N.
Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

Kundu, Prasun K.
Optimal Strategies for Validating TRMM Rainfall Estimates with Rain-Gauge Data – 75

Kurdyla, D.
Climate Controls on Carbon Sequestration in Eastern North America – 92

Kuulkers, E.
The Complete Z-diagram of LMC X-2 – 117

Kwadrat, Carl F.
Inter-Satellite Communications Considerations and Requirements for Distributed Spacecraft and Formation Flying Systems – 13

La, A.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

LaBel, K. A.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

LaBel, Ken A.
In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

LaBel, Kenneth A.
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Flight Experiments for Living With a Star Space Environment Testbed (LWS-SET): Relationship to Technology – 18

Radiation Requirements and Requirements Flowdown: Single Event Effects (SEEs) and Requirements – 22

Lachtrupp, T. P.
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Ladbury, Ray L.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

LaMarre, C.
Venus Atmospheric Exploration by Solar Aircraft – 130

Landi, B. J.
Nanostructured Materials Development for Space Power – 36

Landis, Geoffrey A.
Colonization of Venus – 129

High Altitude Launch for a Practical SSTO – 12

Venus Atmospheric Exploration by Solar Aircraft – 130

Landis, Geoffrey
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Larko, D.
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Larraber, D. C.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Lau, William K. M.
Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Model Interpretation of Climate Signals: Application to the Asian Monsoon Climate – 86

Lau, William K.-M.
MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Lawrence, G. R.
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Lawson, J.
Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

LeBel, Kenneth A.
On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

Lee, Albert
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

Lee, R. Q.
Multi-Beam Phased Array Antennas – 45

Lee, Taesul
Relative Navigation of Formation-Flying Satellites – 17

Lee, Timothy J.
The Anharmonic Force Field of BeH2 Revisited – 110

Leete, Stephen J.
Satellite Servicing in Mission Design Studies at the NASA GSFC – 21

Leftwich, T. E.
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

Leidecker, Henning
Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

Leitner, Jesse A.
Benchmark Problems for Space Mission Formation Flying – 54

Investigation of Space Interferometer Control Using Imaging Sensor Output Feedback – 28

Lelieveld, J.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Lemoine, F. G.
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Lemoine, Frank G.
Evaluation of GEOSAT Follow-On Precise Orbit Ephemeris – 13

Leonov, Arkady I.
A Thermodynamic Theory of Solid Viscoelasticity. Part 3: Nonlinear Glassy Viscoelasticity, Stability Constraints, Specifications – 43

Lerch, B. A.
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Leung, Dominic
Relative Navigation of Formation-Flying Satellites – 17

Leventis, Nicholas
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

Levy, Robert C.
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Li, B. Q.
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Li, J.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Li, Jian-Zhong
Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

Li, K. E.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Li, K.
Effect of Magnetic Fields on g-jitter Induced Convection and Solute Striation During Space Processing of Single Crystals – 44

Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Li, Rong-Rong
Remote Sensing of Suspended Sediments and Shallow Coastal Waters – 62

Li, X.
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Liang, Shoudan
Redundancies in Large-scale Protein Interaction Networks – 94

Lin, S. J.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Lineberry, C. W.
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Lineberry, J. T.
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Linker, Jon A.
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

Lionello, Roberto
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

Lissenden, C. J.
Behavior of Three Metallic Alloys under Combined Axial-Shear Stresses at Elevated Temperature – 41

Lissenden, Cliff J.
Multiaxial Constitutive Model Accounting for the Strength-Differential in Inconel 718 – 40

Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

Litchford, R. J.
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Liu, H. Y.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Liu, J.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Liu, Nan-Suey
Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

Liu, S.-Y.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Livingston, John M.
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Lombardo, D. C.
Importance of Reliability Assessment to Helicopter Structural Component Fatigue Life Prediction – 4

Lommen, A. N.
New Pulsars from Arecibo Drift Scan Searches – 118

Long, Anne
Relative Navigation of Formation-Flying Satellites – 17

Lorimer, D. R.
New Pulsars from Arecibo Drift Scan Searches – 118

Lovas, F. J.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Interstellar Antifreeze: Ethylene Glycol – 116

Lubin, Lori M.
A Detailed Study of Two Optically-Selected, High-Redshift Clusters of Galaxies – 125

Luckring, J. M.
Transonic Reynolds Number and Leading-Edge Bluntness Effects on a 65 deg Delta Wing – 2

Luers, Phil
Timekeeping for the Space Technology 5 (ST-5) Mission – 26

Luquette, Richard J.
A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

Lutchke, S.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Luthcke, Scott B.
Jason-1 Precise Orbit Determination from GPS Tracking: Method, Performance and Calibration of the Lc Phase Center Offset – 15

JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Lyons, Valerie
Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models – 65

High Altitude Launch for a Practical SSTO – 12

High Voltage Space Solar Arrays – 9

Ma, Chopo
The Goddard VLBI SINEX Files – 101

MacKenty, John W.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

MacNeice, Peter
Interface Conditions for Wave Propagation Through Mesh Refinement Boundaries – 104

Madejski, G.
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

Maenza-Gmeich, T.
Climate Controls on Carbon Sequestration in Eastern North America – 92

Maghami, P. G.
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Precision Pointing for the Laser Interferometry Space Antenna Mission – 53

Mailhe, L. M.
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Mailhe, Laurie M.
A Comparison of Trajectory Optimization Methods for the Impulsive Minimum Fuel Rendezvous Problem – 29

Maki, G.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Makridenko, L.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Maly, Joseph R.
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Manfroid, J.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Mannino, Antonio
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Maranchi, Jeffrey P.
Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

Marchenko, S.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Margasahayam, Ravi
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

Marguia, J.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Maring, Hal
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Markley, F. L.
Design and Analysis of the ST7 Disturbance Reduction System (DRS) Spacecraft Controller – 20

Marquardt, Eric D.
Cryogenic Information Center – 34

Marshak, Alexander
A New Look into the Effect of Large Drops on Radiative Transfer Process – 80

Martin, Jan M. L.
The Anharmonic Force Field of BeH2 Revisited – 110

Martin, John
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

Martuch, Robert A.
Synthesis,and structural characterization of [(CH3(C5H4N))Ga(SCH2(CO)O)]-[(4-MepyH)]+, a novel Ga(III) five coordinate complex. – 38

Marvis, Dimitri N.
Exploration of Advanced Probabilistic and Stochastic Design Methods – 1

Mashnik, S. G.
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Production of Pions in pA-collisions – 112

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

Maslanik, James A.
Space/Time Statistics of Polar Ice Motion – 77

Mason, Paul
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

Mastichladis, A.
The 'Supercritical Pile' Model for GRB: Tapping the Proton Energy and Getting the vFv peak at approx. 1 MeV – 111

Matsumoto, H.
Progress in Search for Antihelium with BESS – 66

McClain, Charles
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

McDonald, F. B.
Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

McFadin, Lou
Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

McGee, Thomsa J.
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

McLaughlin, M. A.
New Pulsars from Arecibo Drift Scan Searches – 118

McMillian, W. Wallace
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

McNally, Mark
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

McQuillen, John
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

McRae, D. Scott
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

Medina, Barbara
A Virtual Mission Operations Center - Collaborative Environment – 11

Mehta, Ashesh D.
Neural Dynamics Underlying Event-Related Potentials – 95

Memarsadeghi, Nargess
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

Mendelsohn, C. R.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Mendoza, C.
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

Mentzell, J. Eric
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Menzel, W. Paul
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Merkowitz, Stephen M.
Development of a Thrust Stand to Meet LISA Mission Requirements – 29

Mewaldt, R. A.
Two Components in Major Solar Particle Events – 131

Michalak, Travis
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Middleton, Elizabeth
Low/Medium Density Biomass, Coastal and Ocean Carbon: A Carbon Cycle Mission – 94

Mikic, Zoran
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

Miller, David
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Miller, Robert A.
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Mills, Vanessa
Implicit Communication in Novice and Expert Teams – 95

The Effects of Information Technology on Intra-Human Communication in the Workplace – 96

The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Millsaps, Gary D.
Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

Mink, Ronald G.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Miranda, Felix A.
K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

Mitchell, J. W.
Precise Measurements of the Cosmic Ray Antiproton Spectrum with BESS Including the Effects of Solar Modulation – 131

Moeller, Christopher C.
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Moffat, A. F. J.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Mohling, Robert A.
Cryogenic Information Center – 34

Monroe, Joseph
Integration of NASA Research into Undergraduate Education in Math, Science, Engineering and Technology at North Carolina A&T State University – 44

Montoya, Alex F.
Material Outgassing, Identification and Deposition, MOLIDEP System – 52

Moody, Eric G.
Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Moore, A.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Moreau, Michael
GPS-Based Navigation And Orbit Determination for the AMSAT AO-40 Satellite – 9

Moreels, Pierre
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Morscher, Gregory N.
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Morton, Thomas
Estimation of The Radiation Environment Based On The NASA Ap-8 and Ae-8 Models – 65

Mosher, Marianne
An Exploration of Discontinuous Time Synchronous Averaging for Helicopter HUMS Using Cruise and Terminal Area Vibration Data – 7

Mosier, Carol L.
MAP Propulsion System Thermal Design – 24

Moskalenko, I. V.
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Production of Pions in pA-collisions – 112

Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

Mueller, C. H.
High Mobility SiGe/Si Transistor Structures on Sapphire Substrates Using Ion Implantation – 109

Mueller, Carl H.
K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

Mukai, K.
The Origin of Soft X-rays in DQ Herculis – 122

Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

Murray, Stephen S.
HEASARC Software Archive – 98

Mushotzky, R.
The Intercluster Medium in Clusters – 117

Mushotzky, Richard F.
X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

Mushotzky, Richard
Coronal Structures in Cool Stars: XMM-NEWTON Hybrid Stars and Coronal Evolution – 120

Muslimov, Alex G.
Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

Myers, Dwight L.
Alumina Volatility in Water Vapor at Elevated Temperatures – 40

Myers, Jerry G.
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

Myhre, Craig A.
The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

Naasz, Bo J.
Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 10

Naasz, Bo
First Results from a Hardware-in-the-Loop Demonstration of Closed-Loop Autonomous Formation Flying – 19

Integrated Orbit and Attitude Control for a Nanosatellite with Power Constraints – 23

Nahra, Henry K.
Prediction of Bubble Diameter at Detachment from a Wall Orifice in Liquid Cross Flow Under Reduced and Normal Gravity Conditions – 51

Nakai, Junko
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

Nakajima, Y.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Nakano, Aiichiro
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Nash, Eric R.
On the Size of the Antarctic Ozone Hole – 65

Naze, Y.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Negri, Andrew
Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

Nelkin, Eric
Global Precipitation Analyses (3-Hourly to Monthly) Using TRMM, SSM/I and other Satellite Information – 81

Monitoring Global Precipitation Using Satellite Observations: Status and Future – 92

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Nelson, B.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Nemani, Ramakrishna
Automating the Processing of Earth Observation Data – 66

Nesbitt, J. A.
Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Nesbitt, James A.
Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Neudeck, Philip G.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Newman, Paul A.
On the Size of the Antarctic Ozone Hole – 65

Ning, C. Z.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Ning, Cun-Zheng
Microscopic Modeling of Intersubband Optical Processes in Type II Semiconductor Quantum Wells: Linear Absorption – 110

Spurious States-Free Solution of the k dot p Hamiltonian for Heterostructures – 46

Noebe, R. D.
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Noebe, Ronald D.
Modeling of the Site Preference in Ternary B2-Ordered Ni-Al-Fe Alloys – 41

Site Occupancy of Ternary Additions to B2 Alloys – 39

Noronha, Conan
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Norris, J. P.
Strategies for Studying the Sources of Gamma Ray Bursts – 118

North, Steve
Visualizing Decision-making Behaviours in Agent-based Autonomous Spacecraft – 8

Nozaki, M.
Progress in Search for Antihelium with BESS – 66

OBryan, Martha V.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

O'Donnell, James R., Jr.
The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

Ohl, Raymond G.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Okojie, Robert S.
High-Temperature Electronics: A Role for Wide Bandgap Semiconductors? – 111

Oldham, Timothy R.
Switching Oxide Traps – 47

Oliversen, Ronald J.
Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

Seeing Red and Shooting Blanks: A Study of Red Quasars And Blank Field X-Ray Sources – 120

Oliverson, Ronald J.
US Astronomers Access to SIMBAD in Strasbourg, France – 114

Olsen, M. A.
A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

Olson, Williams S.
Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Oltmans, S. J.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Oltmans, Samuel
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

OMalley, Terence F.
The Fluids And Combustion Facility Combustion Integrated Rack And The Multi-User Droplet Combustion Apparatus: Microgravity Combustion Science Using Modular Multi-User Hardware – 44

Opila, Elizabeth J.
Alumina Volatility in Water Vapor at Elevated Temperatures – 40

Oreopoulos, L.
Overlap Properties of Clouds Generated by a Cloud Resolving Model – 76

Ormes, J. F.
Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

Ortland, Dave
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Osiander, R.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Ottenstein, Laura
Flight Testing of the Capillary Pumped Loop 3 Experiment – 20

Thermal Vacuum Testing of a Novel Loop Heat Pipe Design for the Swift BAT Instrument – 48

Otterman, J.
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Paerels, F.
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

Pahre, Michael A.
Evolution of Galaxies and the Star Formation Rate in the Infrared – 64

Palm, Stephen
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Palmer, Patrick
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Palmeri, P.
A Complete Set of Radiative and Auger Rates for K-vacancy States in Fe XVIII-Fe XXV – 123

Atomic Data for the K-Vacancy States of Fe XXIV – 121

Pang, Wan-Lin
Automating the Processing of Earth Observation Data – 66

Pappa, Richard S.
Membrane Vibration Tests Using Surface-Bonded Piezoelectric Patch Actuation – 45

Park, Chan Hong
Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

Parke, William
New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

Parker, Bradford H.
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Pasareanu, Corina S.
Foundations of the Bandera Abstraction Tools – 100

Patterson, J.
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

Pawson, S.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Pawson, Steve
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Pawson, Steven
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Pedelty, J. A.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Pegion, Philip J.
Causes of Long-Term Drought in the USA Great Plains – 86

Pendleton, Scott C.
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Peteet, D. M.
Climate Controls on Carbon Sequestration in Eastern North America – 92

Peters, W.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Petersen, Ruth
Science Through ARts (STAR) – 112

Peterson, J. R.
Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

Petre, R.
Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Petrov, Leonid
The Goddard VLBI SINEX Files – 101

Phalane, N. Agnes
Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

Phillips, D. R.
Further Developments in the MLPG Method for Beam Problems – 57

Pierce, Harold F.
Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

Pincus, Robert
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Platnick, Steven
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Multispectral Cloud Retrievals from MODIS on Terra and Aqua – 81

Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Poirier, D. R.
Directional Solidification and Convection in Small Diameter Crucibles – 41

Poivey, C.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Poivey, Christian
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

On the Utilization of In-flight Radiation-induced Performance Data and Anomaly Resolution of Commercial Off the Shelf (COTS) Electronics – 27

Poli, Paul
Evaluation of Refractivity Profiles from CHAMP and SAC-C GPS Radio Occultation – 67

Ponchak, G. E.
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Popovic, Z.
Multi-Beam Phased Array Antennas – 45

Potts, L. V.
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

Potts, Laramie V.
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Powell, J. Anthony
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Prabhakara, C.
Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimension Model – 75

Prabhakaran, R.
An Experimental Investigation of Damage Resistances and Damage Tolerance of Composite Materials – 33

Prina, Mauro
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Prospero, J.
Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

Pulliam, Thomas H.
Aerodynamic Shape Optimization using an Evolutionary Algorithm – 4

Quick, B. E.
Estimation of Transpiration and Water Use Efficiency Using Satellite and Field Observations – 84

Raeder, Kevin
Singular Vectors for Moisture-Measuring Norms – 92

Raffaelle, Ryne P.
Nanocrystalline CuInS2 And CuInSe2 via Low-Temperature Pyrolysis Of Single-Source Molecular Precursors – 37

Nanostructured Materials Development for Space Power – 36

Synthesis and Characterization of Thin Film Lithium-Ion Batteries Using Polymer Electrolytes – 47

Raffaelle, Ryne
Future Photovoltaic Power Generation for Space-Based Power Utilities – 64

Raj, S. V.
An Assessment of the Residual Stresses in Low Pressure Plasma Sprayed Coatings on an Advanced Copper Alloy – 39

Rajkumar, T.
Training Data Requirement for a Neural Network to Predict Aerodynamic Coefficients – 1

Raju, I. S.
Further Developments in the MLPG Method for Beam Problems – 57

Rakow, Glenn
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

Rallison, Richard D.
Holographic Optical Elements as Scanning Lidar Telescopes – 108

Randel, William
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Randriambelo, Tantely
Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Rao, Gopalakrishna M.
Hubble Space Telescope On-orbit NiH2 Battery Performance – 25

NiH2 Cycle Life Study – 47

Raphael, Dave
Timekeeping for the Space Technology 5 (ST-5) Mission – 26

Rash, James
Internet Technology for Future Space Missions – 15

Rawashdeh, Abdel-Monem M.
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

Reale, Oreste
A Classification of Mediterranean Cyclones Based on Global Analyses – 85

Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Reames, D. V.
Wind Observations of Anomalous Cosmic Rays from Solar Minimum to Maximum – 127

Reed, Benjamin B.
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Reed, Robert A.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Reichardt, Jens
Three-Signal Method for Accurate Measurements of Depolarization Ratio with Lidar – 88

Reimer, O.
Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

Reinhardt, K.
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

Remer, L.
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Remer, Lorraine A.
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Remer, Lorraine
MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Renik, B.
Climate Controls on Carbon Sequestration in Eastern North America – 92

Reuter, D.
Development of a 4-15 micron Infrared GaAs Hyperspectral QWIP Imager (HQI) – 111

Revercomb, H.
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Revercomb, Henry E.
Remote Sensing of Smoke, Land and Clouds from the NASA ER-2 during SAFARI 2000 – 62

Richardson, I. G.
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Interplanetary Coronal Mass Ejections in the Near-Earth Solar Wind During 1996-2002 – 131

Riggs, George A.
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Riley, Pete
Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse – 66

Ringwald, F. A.
The Origin of Soft X-rays in DQ Herculis – 122

Riordan, Kevin
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Robbins, Kay A.
Changing the Paradigm: Preparing Students for the Computing Profession in the 21st Century – 97

Robby
Foundations of the Bandera Abstraction Tools – 100

Roberts, Gary D.
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Robertson, Brent
Satellite GN and C Anomaly Trends – 15

Robinson, David W.
Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

Rodriquez, Jose
Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

Roman, D. R.
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

Romanofsky, Robert
K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

Romisch, S.
Multi-Beam Phased Array Antennas – 45

Rood, R. B.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Rood, Richard
The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

Rosenberg, Linda
Using Pilots to Assess the Value and Approach of CMMI Implementation – 102

Ross, Brian
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

Rothman, Laurence
High-Resolution Spectroscopic Database for the NASA Earth Observing System Program – 58

Rowlands, D. D.
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Rubincam, David Parry
Polar Wander on Triton and Pluto Due to Volatile Migration – 129

Rukhovets, Leonid
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

Russell, Philip B.
Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

Ryu, Jung-Hee
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Saaroni, H.
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Sabra, Bassem M.
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

Saeki, T.
Progress in Search for Antihelium with BESS – 66

Safren, Harvey
In-Flight Observations of Long-Term Single Event Effect(SEE)Performance on Orbview-2 and Xray Timing Explorer(XTE)Solid State Recorders (SSR) – 22

Saini, Subhash
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Saleeb, Atef F.
Plastic Coupling and Stress Relaxation During Nonproportional Axial-Shear Strain-Controlled Loading – 56

Salikhov, R.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Salomonson, Vincent V.
Snow and Ice Products from the Moderate Resolution Imaging Spectroradiometer – 59

Samanta, Manoj Pratim
Redundancies in Large-scale Protein Interaction Networks – 94

Sank, Victor
Timekeeping for the Space Technology 5 (ST-5) Mission – 26

Sanneman, Paul
On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

Sanner, Robert M.
A Nonlinear, Six-Degree of Freedom Precision Formation Control Algorithm, Based on Restricted Three Body Dynamics – 8

Sasa, S.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Sasaki, M.
Progress in Search for Antihelium with BESS – 66

Schiff, C.
Primer Vector Optimization: Survey of Theory, New Analysis and Applications – 97

Schlegel, E. M.
Chandra Observation of the X-ray Source Population of NGC 6946 – 123

Schmidt, H. J.
Magnetohydrodynamic Augmented Propulsion Experiment: I. Performance Analysis and Design – 12

Schneider, Steven J.
Catalyzed Ignition of Bipropellants in Microtubes – 29

Schneider, W.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Schnurr, Richard
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

Schoeber, M. R.
A Comparison of Northern and Southern Hemisphere Cross-tropopause Ozone Flux – 68

Schoeberl, Mark R.
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Schoener, Wolfgang
Changes in the Pasterze and the Kleines Fleisskees Glaciers, Austria, as Measured from the Ground and Space – 61

Schroder, Michael
Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua – 18

Schroeder, Charles E.
Neural Dynamics Underlying Event-Related Potentials – 95

Schubert, Siegfried D.
Causes of Long-Term Drought in the USA Great Plains – 86

Schwabacher, Mark
Mining Distance Based Outliers in Near Linear Time with Randomization and a Simple Pruning Rule – 105

Schwartz, Z.
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Schwemmer, Geary K.
Holographic Optical Elements as Scanning Lidar Telescopes – 108

Schwemmer, Geary
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Scialdone, John J.
Material Outgassing, Identification and Deposition, MOLIDEP System – 52

Seah, Chin
Modeling and Simulation for Mission Operations Work System Design – 115

Seidleck, Christine
A NASA Perspective and Validation and Testing of Design Hardening for the Natural Space Radiation Environment (GOMAC Tech 03) – 56

Shabano, Leonid
Arithmetic Data Cube as a Data Intensive Benchmark – 103

Shah, Ankoor S.
Neural Dynamics Underlying Event-Related Potentials – 95

Shakoorzadeh, Kamdin
Reliable Transport over SpaceWire for James Webb Space Telescope (JWST) Focal Plane Electronics (FPE) Network – 14

Shepherd, J. Marshall
A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

NASA's Sentinels Monitoring Weather and Climate: Past, Present, and Future – 79

Rainfall Modification by Urban Areas: New Perspectives from TRMM – 90

Shie, C.-H.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Shie, Chung-Lin
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Shields, Joseph C.
The Nature of the UV/X-ray Absorber In PG 2302+029 – 115

Shimojo, Fuyuki
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Shirron, Peter J.
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Shivakumar, Kunigal
Carbon Fiber Reinforced Ceramic Composites for Propulsion Applications – 33

Shu, Peter K.
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Shu, Y.
Fluid Flow and Solidification Under Combined Action of Magnetic Fields and Microgravity – 48

Sierhuis, Maarten
Modeling and Simulation for Mission Operations Work System Design – 115

Sierk, A. J.
CEM2k and LAQGSM Codes as Event-Generators for Space Radiation Shield and Cosmic Rays Propagation Applications – 112

Silk, Eric
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Silver, E.
Microcalorimeters with Germanium Thermistors for High Resolution Soft and Hard X-ray Astronomy – 51

Simons, Stephen N.
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

Simpson, Alda D.
Low Frequency High Amplitude Temperature Oscillations in Loop Heat Pipe Operation – 49

Simpson, Alda
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

Simpson, J.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Simpson, S.
The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Sims, Michael H.
Modeling and Simulation for Mission Operations Work System Design – 115

Sireli, Yesim
A Product Development Decision Model for Cockpit Weather Information Systems – 72

Skalkowski, G.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Skillman, D. R.
X-ray Variability of the Magnetic Cataclysmic Variable V1432 Aql and the Seyfert Galaxy NGC 6814 – 126

Skinner, Stephen L.
XMM-Newton X-ray Observatory Guest Observer program (AO-1) at CASA – 128

Skocik, Christopher
The Design of a Remotely Operated Shutter (ROS) for Thermal Vacuum Testing – 55

Slojkowski, Steven
Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

Smale, A. P.
The Complete Z-diagram of LMC X-2 – 117

Smale, Alan P.
The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

Smart, Michael K.
Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

Smith, E. A.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Smith, Eric A.
Advances In Understanding Global Water Cycle With Advent of GPM Mission – 61

Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Relationship Between GPM Mission and NASA's Global Water Cycle Research Program – 73

Smith, Ira S.
An Overview of the NASA Sounding Rocket and Balloon Programs – 3

Smith, James
Dynamic Testing of a Subscale Sunshield for the Next Generation Space Telescope (NGST) – 57

Snyder, L. E.
A Sensitive VLA Search for Small-Scale Glycine Emission Toward OMC-1 – 127

Sockol, Peter M.
Multigrid Solution of the Navier-Stokes Equations at Low Speeds with Large Temperature Variations – 48

Sokolsky, P.
Effect of Clouds on Apertures of Space-based Air Fluorescence Detectors – 126

Soltis, James V.
Space Nuclear Power and Propulsion Systems Technology: Enabling Future Planetary Exploration. Segment 7: Power Management and Distribution – 30

Sotiriou-Leventis, Chariklia
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

Spitz, Nicolas
Predicting Modes of the Unsteady Vorticity Field Near the Trailing Edge of a Blade – 2

Spry, David J.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Spry, David
Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Spuckler, C. M.
Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Stajner, I.
High-Frequency Planetary Waves in the Polar Middle Atmosphere as seen in a data Assimilation System – 68

Starr, D. OC.
Circumpolar Circulation Patterns Over the Northern Hemisphere Oceans in Late Winter, 1949-2002. – 83

Starr, D.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Starr, David O'C.
Version 2 Goddard Satellite-Based Surface Turbulent Fluxes (GSSTF2) – 85

Starr, David
Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 90

Stavely, Richard A.
Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly – 107

Steffan, Christopher
Three Dimensional Numerical Simulation of Rocket-Based Combined-Cycle Engine Response During Mode Transition Events – 6

Steiner, Mark D.
Amateur Radio on the International Space Station: The First Operational Payload on the ISS – 16

Steiner, Mark
The Integrated Mission Design Center (IMDC) at NASA Goddard Space Flight Center – 130

Steinetz, Bruce M.
Advanced Control Surface Seal Development at NASA GRC for 3rd Generation RLV – 56

Stevens, I. R.
An X-ray Investigation of the NGC 346 Field in the SMC (2): The Field Population – 124

Still, M.
The Origin of Soft X-rays in DQ Herculis – 122

Stone, R. F.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Stoneking, Eric
Satellite GN and C Anomaly Trends – 15

Stothard, Christina
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Street, K. W.
Health Monitoring of Thermal Barrier Coatings by Mid-Infrared Reflectance – 55

Street, Kenneth
Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Strohmayer, Tod E.
X-ray QPOs from the Ultra-luminous X-ray Source in M82: Evidence Against Beaming – 121

Strong, A. W.
Propagation of Secondary Antiprotons and Cosmic Rays in the Galaxy – 70

Strow, L. Larrabee
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Stueben, Heather
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

Sturner, S. J.
Observation of Nonthermal Emission from the Supernova Remnant IC443 with RXTE – 126

Suarez, Max J.
Causes of Long-Term Drought in the USA Great Plains – 86

Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

Sud, Y.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Sun, Q.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Sung, Chih-Jen
Catalyzed Ignition of Bipropellants in Microtubes – 29

Sung, P. K.
Directional Solidification and Convection in Small Diameter Crucibles – 41

Svizhenko, A.
Where is scattering important in nanotransistors? – 46

Swain, Kelly
Implicit Communication in Novice and Expert Teams – 95

Swank, Jean H.
New Evidence For Proton Cyclotron Resonance In a Magnetar Strength Field From SGR 1806-20 – 125

Swanson, Ted D.
Controlling Variable Emittance (MEMS) Coatings for Space Applications – 22

Swanson, Ted
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Swanson, Theodore D.
NASA Thermal Control Technologies for Robotic Spacecraft – 23

Swinbank, Richard
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Szabo, A.
Are CME 'interactions' Really Important for Accelerating Major Solar Energetic Particle Events? – 125

Tanre, Didier
Cloud and Aerosol Properties, Precipitable Water, and Profiles of Temperature and Water Vapor from MODIS – 84

Evaluation of the MODIS Retrievals of Dust Aerosol over the Ocean during PRIDE – 70

MODIS Satellite Data and GOCART Model Characterization of the Global Aerosol – 80

Tao, Wei-Kuo
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Microphysics, Radiation and Surface Processes in the Goddard Cumulus Ensemble (GCE) Model – 68

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-resolving Model – 87

Sensitivity of Precipitation Processes to Microphysics and Resolution in a Cloud-Resolving Model – 89

The Impact of Aerosols on Cloud and Precipitation Processes: Cloud-Resolving Model Simulations – 73

Tao, W.-K.
Precipitation Processes developed during ARM (1997), TOGA COARE(1992), GATE(1 974), SCSMEX(1998) and KWAJEX(1999): Consistent 2D and 3D Cloud Resolving Model Simulations – 86

Taylor, Layi
A Dynamic Optimization Technique for Siting the NASA-Clark Atlanta Urban Rain Gauge Network (NCURN) – 83

Taylor, Patrick T.
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

Tenenbaum, Joel
Jet Stream Analysis and Forecast Errors Using GADS Aircraft Observations in the DAO, ECMWF, and NCEP Models – 88

Teverovsky, Alexander
Instructions for Plastic Encapsulated Microcircuit(PEM) Selection, Screening and Qualification. – 26

Tewari, S. N.
Directional Solidification and Convection in Small Diameter Crucibles – 41

Thomas-Ogbuji, Linus
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Thompson, A. M.
Tropospheric Ozone Over a Tropical Atlantic Station in the Northern Hemisphere: Paramaribo, Surinam (6 deg N, 55 deg W) – 60

Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

Thompson, A.
A Climatology of Tropospheric CO over the Central and Southeastern USA and the Southwestern Pacific Ocean Derived from Space, Air, and Ground-based Infrared Interferometer Spectra – 59

Thompson, Anne M.
Insights into Tropical Tropospheric Ozone from Satellite and Sonde Data – 93

Investigation of the Short-Time Variability of Tropical Tropospheric Ozone – 62

Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

Thompson, William K.
Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Tilton, James C.
Recursive Hierarchical Image Segmentation by Region Growing and Constrained Spectral Clustering – 101

The Intelligent Data Understanding Element of NASA's Intelligent Systems Program – 103

Titarchuk, Lev
Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

Rayleigh-Taylor Gravity Waves and Quasiperiodic Oscillation Phenomenon in X-ray Binaries – 116

Titus, Jeff L.
Current Single Event Effects and Radiation Damage Results for Candidate Spacecraft Electronics – 27

Tomasek, Aaron J.
Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

Tomsick, John A.
State Transitions and QPOs in Black Hole Candidate X-Ray Transients During Outburst Decay – 119

Torres, O.
Effects of Non-Sphericity on Mineral Dust Modeling – 71

Long-Term Simulation of Dust Distribution with the GOCART Model: Correlation with the North Atlantic Oscillation – 74

Trepte, C.
Initial Operation and Checkout of Stratospheric Aerosol Gas Experiment and Meteor-3M Satellite – 79

Trexler, Carl A.
Mach 4 Performance of a Fixed-Geometry Hypersonic Inlet with Rectangular-to-Elliptical Shape Transition – 30

Trimble, Jay P.
Modeling and Simulation for Mission Operations Work System Design – 115

Trimble, Jay
Human Centered Design and Development for NASA's MerBoard – 100

Trunek, Andrew J.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Trunek, Andrew
Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Truong, Son H.
Orbit Determination Support for the Microwave Anisotropy Probe (MAP) – 20

Tsay, Si-Chee
Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment(BASE-ASIA) – 65

Characterization of Dust Properties during ACE-Asia and PRIDE: A Column Satellite-Surface Perspective – 81

Tsuji, Luis
Long-Term Isothermal Aging Effects on Weight Loss, Compression Properties, and Dimensions of T650-35 Fabric-Reinforced PMR-15 Composites-Data – 35

Tumer, Kagan
Collectives for the Optimal Combination of Imperfect Objects – 105

Tumer, K.
Collectives for Multiple Resource Job Scheduling Across Heterogeneous Servers – 99

Turk, J.
Calibration Plans for the Global Precipitation Measurement (GPM) – 63

Turk, Kendra
Carbon and Oxygen Budgets of Hypersaline Cyanobacterial Mats: Effects of Tidal Cycle and Temperature – 96

Turner, M. W.
Magnetic Flux Compression Experiments Using Plasma Armatures – 32

Tuttle, James G.
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Udelhofen, Petra
SPARC Intercomparison of Middle Atmosphere Climatologies – 72

The SPARC Intercomparison of Middle Atmosphere Climatologies – 79

Udrea, Bogdan
WOBBLE: A Proposed Mission to Characterize Past and Present Water on Mars – 128

Ueda, K.
Intersubband Transitions in InAs/AlSb Quantum Wells – 46

Ulbert, Istvan
Neural Dynamics Underlying Event-Related Potentials – 95

Underwood, P.
Recent Enhancements to the National Transonic Facility – 9

Valeriano, D.
Imaging Laser Altimetry in the Amazon: Mapping Large Areas of Topography, Vegetation Height and Structure, and Biomass – 58

Vandenburg, Yvonne Yoder
The Electrical and Thermal Conductivity of Woven Pristine and Intercalated Graphite Fiber-Polymer Composites – 36

VandenDool, Huug M.
Observational Evidence that Soil Moisture Variations Affect Precipitation – 76

VanderWal, Randy L.
Carbon Nanostructure Examined by Lattice Fringe Analysis of High Resolution Transmission Electron Microscopy Images – 38

VanDerWijngaart, Rob F.
Applicability of Markets to Global Scheduling in Grids: Critical Examination of General Equilibrium Theory and Market Folklore – 114

VanKeuls, Fred
K-Band Reflectarray Antenna Based on Ferroelectric Thin Films: What Have We Learned so Far – 35

Vashishta, Priya
Scalability of a Low-Cost Multi-Teraflop Linux Cluster for High-End Classical Atomistic and Quantum Mechanical Simulations – 98

Vasikov, Alexander
Retrieval Of Cloud Pressure And Chlorophyll Content Using Raman Scattering In GOME Ultraviolet Spectra – 82

Vayner, B. V.
High Voltage Space Solar Arrays – 9

Verrilli, Michael J.
Influence Of Holes On The In-Plane Tensile Strength And Fatigue Durability Of A NICALON(Trademark)/Si-N-C Ceramic Matrix Composite – 34

Temperature Dependence on the Strength and Stress Rupture Behavior of a Carbon-Fiber Reinforced Silicon Carbide (C/SiC) Composite – 37

Vetter, William M.
Enlargement of Step-free SiC Surfaces by Homoepitaxial Web-growth of Thin SiC Cantilevers – 110

Homoepitaxial 'Web Growth' of SiC to Terminate C-Axis Screw Dislocations and Enlarge Step-Free Surfaces – 38

Vieira, G.
Global Properties of the Ejecta Absorptions in the Spectrum of Eta Carinae – 70

Properties of the -513 km/s Ejecta in the Spectrum of Eta Carinae – 119

The -145 km/s Absorption System of Eta Carinae – 118

Viens, Michael J.
Life Cycle Testing of Viscoelastic Material for Hubble Space Telescope Solar Array 3 Damper – 24

Vigneau, Danielle N.
Large Coded Aperture Mask for Spaceflight Hard X-ray Images – 21

Voellmer, George M.
A Cryogenic, Insulating Suspension System for the High Resolution Airborne Wideband Camera (HAWC)and Submillemeter And Far Infrared Experiment (SAFIRE) Adiabatic Demagnetization Refrigerators (ADRs) – 45

Voemel, H.
Tropospheric Ozone Over the North Pacific from Ozonesdonde Observations – 83

vonFrese, R. R. R. B.
Crustal Structure of the Iceland Region from Spectrally Correlated Free-air and Terrain Gravity Data – 67

vonFrese, Ralph R. B.
Satellite-Altitude Geopotential Study of the Kursk Magnetic Anomaly (KMA) – 106

Utility of Satellite Magnetic Observations for Estimating Near-Surface Magnetic Anomalies – 68

vonRosenvinge, T. T.
Two Components in Major Solar Particle Events – 131

Votava, Petr
Automating the Processing of Earth Observation Data – 66

Vu, Bruce
Sound Propagation from a Supersonic Jet Flowing through a Rigid-walled Duct with a J-Deflector – 7

Waithe, Kenrick A.
Source Term Model for an Array of Vortex Generator Vanes – 50

Waluschka, Eugene
LISA Optics Model – 53

Wang, Bin
Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

Wang, Len
Flaw Tolerance In Lap Shear Brazed Joints – 57

Wang, Li-Qin
Flaw Tolerance in Lap Shear Brazed Joints – 54

Wang, Zhe-In
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Wang, Zhien
Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Ward, David K.
The Microwave Anisotropy Probe (MAP) Guidance, Navigation, and Control Hardware Suite – 23

Ward, John S.
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117

Ward, Philip R.
Balloon Borne Arc-Second Pointer Feasibility Study – 25

Weng, Chi Y.
Effective Frequency Technique – 106

Wey, Thomas
Current Status of Post-Combustor Trace Chemistry Modeling and Simulation at NASA Glenn Research Center – 6

White, Nicholas E.
An XMM-Newton Observation of 4U1755-33 in Quiescence: Evidence for a Fossil X-Ray Jet – 122

Effects of Resonance in Quasi-Periodic Oscillators of Neutron Star Binaries – 124

Extended Acceleration in Slot Gaps and Pulsar High-Energy Emission – 126

Resource Letter GrW-1: Gravitational Waves – 127

The Complete Z-diagram of LMC X-2 – 117

The Long-term Light Curves of X-ray Binaries Contain Simultaneous Periodic and Random Components – 124

The Origin of Soft X-rays in DQ Herculis – 122

Two Components in Major Solar Particle Events – 131

Two Types of Soft X-ray Spectra in Cataclysmic Variables – 118

White, Nicholas
HEASARC Software Archive – 98

White, Rosalie
Amateur Radio On The International Space Station (ARISS) - The First Educational Outreach Program On ISS – 16

Whiteman, David
Lidar Measurements of Wind, Moisture, and Boundary Layer Evolution in a Dry Line during 1HOP 2002 – 77

Lidar Measurements of Wind, Moisture and Boundary Layer Evolution in a Dryline During IHOP2002 – 78

Whitley, Karen S.
Thermal/Mechanical Response of a Polymer Matrix Composite at Cryogenic Temperatures – 42

Whitlow, Woodrow, Jr.
Innovative Airbreathing Propulsion Concepts for High-speed Applications – 30

Wiencek, John M.
Rejuvenation of Spent Media via Supported Emulsion Liquid Membranes – 32

Wilkerson, Thomas D.
Holographic Optical Elements as Scanning Lidar Telescopes – 108

Williams, Douglas
The Use of the Janus Wargame Simulation to Investigate Naturalistic Decision-Making: A Preliminary Examination – 95

Williams, Lawrence
Science Through ARts (STAR) – 112

Williams, T. A.
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Williams, W. D.
Temperature Dependence of Attenuation of Coplanar Waveguide on 4H High Resistivity SIC Through 540C – 36

Willis, William D., III
Development of a Thrust Stand to Meet LISA Mission Requirements – 29

Wilson, A.
Experimental Verification of the Theoretical Prediction of the Phase Structure of a Ni-Al-Ti-Cr-Cu Alloy – 40

Winsor, Robert S.
Optical Testing of Diamond Machined, Aspheric Mirrors for Groundbased, Near-IR Astronomy – 53

Witte, Jacquelyn C.
Linking Horizontal And Vertical Transports of Biomass Fire Emissions to the Tropical Atlantic Ozone Paradox during the Northern Hemisphere Winter Season: II. 1998-1999. – 87

Urban and Rural Ozone Collect over Lusaka (Zambia, 15.5 S, 28 E) during SAFARI-2000 (September 2000) – 72

Wolf, Karl
Science Goal Driven Observing: A Step Towards Maximizing Science Returns and Spacecraft Autonomy – 4

Wolpert, David
Collectives for the Optimal Combination of Imperfect Objects – 105

Wood, Richard M.
The Contributions of Vincent Justus Burnelli – 133

Woodson, Shawn H.
Accomplishments of the Abrupt Wing Stall (AWS) Program and Future Research Requirements – 2

Wright, C. Wayne
Advancement in LIDAR Data Collection: NASA's Experimental Airborne Advanced Research LIDAR – 64

Wu, Li-Guang
Assessing Impacts of Global Warming on Tropical Cyclone Tracks – 78

Wu, Liguang
Effects of Convective Asymmetries on Hurricane Intensity: A Numerical Study – 66

Xapsos, M. A.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Xilouris, K.
New Pulsars from Arecibo Drift Scan Searches – 118

Xu, Yun-Jun
Coupled Attitude and Orbit Dynamics and Control in Formation Flying Systems – 11

Yackovetsky, Robert E.
Small Aircraft Transportation System Simulation Analysis of the HVO and ERO Concepts – 5

Yang, Song
Evaluation of Improvements to the TRMM Microwave Rain Algorithm – 75

Yee, Glenda F.
Time and Space Resolved Heat Transfer Measurements Under Nucleate Bubbles with Constant Heat Flux Boundary Conditions – 49

Yeh, P-S.
Evaluation of an Ultra-Low Power Reed Solomon Encoder for NASA's Space Technology 5 Mission – 19

Yerkes, Kirk
Investigation into the Micro-Gravity Effects on Two-Phase Spray Thermophysics – 49

Yoshizaki, Masanori
Convective Systems Over the Japan Sea: Cloud-Resolving Model Simulations – 90

Yuan, Zeng-Guang
The Filtered Abel Transform and Its Application in Combustion Diagnostics – 31

Yun, Hee Mann
Effect of a BN Interphase that Debonds Between the Interphase and the Matrix In SiC/SiC Composites – 35

Zakrzwski, Charles M.
Development of a Thrust Stand to Meet LISA Mission Requirements – 29

Zakrzwski, Charles
On-Orbit Testing of the EO-1 Pulsed Plasma Thruster – 10

Zelensky, N. P.
JASON-1 Precise Orbit Determination (POD) Through the Combination and Comparison of GPS, SLR, DORIS and Altimeter Crossover Data – 94

Zhang, Guo-Hui
Isocyanate Cross-Linked Silica: Structurally Strong Aerogels – 34

Zhang, Sara
Impact of TRMM and SSM/I Rainfall Assimilation on Global Analysis and QPF – 89

Zhu, Dongming
Development of Advanced Thermal and Environmental Barrier Coatings Using a High-heat-flux Testing Approach – 42

Failure Morphologies of Cyclically Oxidized ZrO2-Based Thermal Barrier Coatings – 109

Zhu, Zhengxin
A Comparison of the Lower Stratospheric Age-Spectra Derived from a General Circulation Model and Two Data Assimilation Systems – 91

Ziemke, G.
Changes in Earth 360 380 nm Reflectivity: 1980 2000 – 108

Changes in Earth 360 to 380 nm Reflectivity: 1980 to 2000 – 88

Ziemke, J. R.
Derivation of Tropospheric Column Ozone from the EPTOMS/GOES Co-Located Data Sets using the Cloud Slicing Technique – 78

Zmuidzinas, Jonas
A CO-12 J=6-5 Map of M82: The significance of warm molecular gas – 117