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Langley Research Center

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WHAT'S INSIDE

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- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

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

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

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Mathematical and Computer Sciences

Physics

Social and Information Sciences

Space Sciences

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.

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01
AERONAUTICS (GENERAL)

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

20070031762 Booz-Allen and Hamilton, Inc., McLean, VA, USA
A Trajectory Algorithm to Support En Route and Terminal Area Self-Spacing Concepts
Abbott, Terence S.; September 2007; 56 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): L-70750D
Report No.(s): NASA/CR-2007-214899; L-70750D; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031762

This document describes an algorithm for the generation of a four dimensional aircraft trajectory. Input data for this algorithm are similar to an augmented Standard Terminal Arrival Route (STAR) with the augmentation in the form of altitude or speed crossing restrictions at waypoints on the route. Wind data at each waypoint are also inputs into this algorithm. The algorithm calculates the altitude, speed, along path distance, and along path time for each waypoint.
Author
Aircraft Approach Spacing; Trajectories; Algorithms; Wind Measurement; Routes

20070031771 NASA Langley Research Center, Hampton, VA, USA
Three-Dimensional Navier-Stokes Calculations Using the Modified Space-Time CESE Method
Chang, Chau-lyan; August 08, 2007; 19 pp.; In English; 43rd AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 July 2007, Cincinnati, OH, USA; Original contains color and black and white illustrations
Report No.(s): AIAA Paper 2007-5818; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031771

The space-time conservation element solution element (CESE) method is modified to address the robustness issues of high-aspect-ratio, viscous, near-wall meshes. In this new approach, the dependent variable gradients are evaluated using element edges and the corresponding neighboring solution elements while keeping the original flux integration procedure intact. As such, the excellent flux conservation property is retained and the new edge-based gradients evaluation significantly improves the robustness for high-aspect ratio meshes frequently encountered in three-dimensional, Navier-Stokes calculations. The order of accuracy of the proposed method is demonstrated for oblique acoustic wave propagation, shock-wave interaction, and hypersonic flows over a blunt body. The confirmed second-order convergence along with the enhanced robustness in handling hypersonic blunt body flow calculations makes the proposed approach a very competitive CFD framework for 3D Navier-Stokes simulations.
Author
High Aspect Ratio; Robustness (Mathematics); Navier-Stokes Equation; Wave Propagation; Sound Waves; Hypersonic Flow; Blunt Bodies

20070032030 NASA Ames Research Center, Moffett Field, CA, USA; Park, Vaughan and Fleming, LLP, Davis, CA, USA
Method and Apparatus for Automatically Generating Airfoil Performance Tables
VanDam, Cornells P., Inventor; Mayda, Edward A., Inventor; Strawn, Roger Clayton, Inventor; 3 Nov. 2005; 20 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC2-5485

Patent Info.: Filed 2 Dec. 2004; US-Patent-Appl-SN-11-004 716; US 2005/0246110
Report No.(s): PB2007-103998; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032030

One embodiment of the present invention provides a system that facilitates automatically generating a performance table for an object, wherein the object is subject to fluid flow. The system operates by first receiving a description of the object and testing parameters for the object. The system executes a flow solver using the testing parameters and the description of the object to produce an output. Next, the system determines if the output of the flow solver indicates negative density or pressure. If not, the system analyzes the output to determine if the output is converging. If converging, the system writes the output to the performance table for the object.

Author

Airfoils; Aerodynamic Characteristics; Air Flow; Flow Measurement; Computer Programs; Aerodynamics

03
AIR TRANSPORTATION AND SAFETY

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

20070031758 NASA Langley Research Center, Hampton, VA, USA

Runway Incursion Prevention System: Demonstration and Testing at the Dallas/Fort Worth International Airport

Jones, Denise R.; Quach, Cuong C.; Young, Steven D.; [2007]; 11 pp.; In English; 20th Digital Avionics Systems Conference, 14-18 Oct. 2001, Daytona Beach, FL, USA; Original contains color illustrations
Contract(s)/Grant(s): RTA 728-60-30-01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031758

A Runway Incursion Prevention System (RIPS) was tested at the Dallas-Ft. Worth International Airport (DFW) in October 2000. The system integrated airborne and ground components to provide both pilots and controllers with enhanced situational awareness, supplemental guidance cues, a real-time display of traffic information, and warning of runway incursions in order to prevent runway incidents while also improving operational capability. A series of test runs was conducted using NASA s Boeing 757 research aircraft and a test van equipped to emulate an incurring aircraft. The system was also demonstrated to over 100 visitors from the aviation community. This paper gives an overview of the RIPS, DFW flight test activities, and quantitative and qualitative results of the testing.

Author

Flight Tests; Runway Incursions; Situational Awareness; Airports

20070031759 NASA Langley Research Center, Hampton, VA, USA

A Distributed Trajectory-Oriented Approach to Managing Traffic Complexity

Idris, Husni; Wing, David J.; Vivona, Robert; Garcia-Chico, Jose-Luis; [2007]; 13 pp.; In English; 7th AIAA Aviation Technology, Integration and Operations Conference (ATIO), 18-20 Sept. 2007, Belfast, Ireland; Original contains color illustrations
Contract(s)/Grant(s): NNA07BA86C; WBS 411931.02.11.07.01.03; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031759

In order to handle the expected increase in air traffic volume, the next generation air transportation system is moving towards a distributed control architecture, in which ground-based service providers such as controllers and traffic managers and air-based users such as pilots share responsibility for aircraft trajectory generation and management. While its architecture becomes more distributed, the goal of the Air Traffic Management (ATM) system remains to achieve objectives such as maintaining safety and efficiency. It is, therefore, critical to design appropriate control elements to ensure that aircraft and groundbased actions result in achieving these objectives without unduly restricting user-preferred trajectories. This paper presents a trajectory-oriented approach containing two such elements. One is a trajectory flexibility preservation function, by which aircraft plan their trajectories to preserve flexibility to accommodate unforeseen events. And the other is a trajectory

constraint minimization function by which ground-based agents, in collaboration with air-based agents, impose just-enough restrictions on trajectories to achieve ATM objectives, such as separation assurance and flow management. The underlying hypothesis is that preserving trajectory flexibility of each individual aircraft naturally achieves the aggregate objective of avoiding excessive traffic complexity, and that trajectory flexibility is increased by minimizing constraints without jeopardizing the intended ATM objectives. The paper presents conceptually how the two functions operate in a distributed control architecture that includes self separation. The paper illustrates the concept through hypothetical scenarios involving conflict resolution and flow management. It presents a functional analysis of the interaction and information flow between the functions. It also presents an analytical framework for defining metrics and developing methods to preserve trajectory flexibility and minimize its constraints. In this framework flexibility is defined in terms of robustness and adaptability to disturbances and the impact of constraints is illustrated through analysis of a trajectory solution space with limited degrees of freedom and in simple constraint situations involving meeting multiple times of arrival and resolving a conflict.
Author
Air Traffic Control; Active Control; Air Traffic; Aircraft Approach Spacing; Functional Analysis; Management Systems; Flow Distribution; Distributed Parameter Systems

20070031836 George Mason Univ., Fairfax, VA, USA
Applying Qualitative Hazard Analysis to Support Quantitative Safety Analysis for Proposed Reduced Wake Separation Conops
Shortle, John F.; Allocco, Michael; [2005]; 8 pp.; In English; In Proceedings of the 6th USA/Europe ATM R and D Seminar, 2005, Baltimore, MD, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNL05AA11G; Copyright; Avail.: Other Sources

This paper describes a scenario-driven hazard analysis process to identify, eliminate, and control safety-related risks. Within this process, we develop selective criteria to determine the applicability of applying engineering modeling to hypothesized hazard scenarios. This provides a basis for evaluating and prioritizing the scenarios as candidates for further quantitative analysis. We have applied this methodology to proposed concepts of operations for reduced wake separation for closely spaced parallel runways. For arrivals, the process identified 43 core hazard scenarios. Of these, we classified 12 as appropriate for further quantitative modeling, 24 that should be mitigated through controls, recommendations, and / or procedures (that is, scenarios not appropriate for quantitative modeling), and 7 that have the lowest priority for further analysis.
Author
Quantitative Analysis; Aircraft Wakes; Aircraft Hazards; Air Traffic; Air Traffic Control; Aircraft Approach Spacing; Approach Control

20070031837 George Mason Univ., Fairfax, VA, USA
Using Qualitative Hazard Analysis to Guide Quantitative Safety Analysis
Shortle, J. F.; Allocco, M.; Proceedings of the 23rd International System Safety Conference; [2005]; 8 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNL05AA11G; Copyright; Avail.: Other Sources

Quantitative methods can be beneficial in many types of safety investigations. However, there are many difficulties in using quantitative methods. Far example, there may be little relevant data available. This paper proposes a framework for using quantitative hazard analysis to prioritize hazard scenarios most suitable for quantitative mziysis. The framework first categorizes hazard scenarios by severity and likelihood. We then propose another metric 'modeling difficulty' that describes the complexity in modeling a given hazard scenario quantitatively. The combined metrics of severity, likelihood, and modeling difficulty help to prioritize hazard scenarios for which quantitative analysis should be applied. We have applied this methodology to proposed concepts of operations for reduced wake separation for airplane operations at closely spaced parallel runways.
Author
Quantitative Analysis; Aircraft Wakes; Aircraft Safety; Aircraft Hazards; Flight Safety; Flight Hazards; Digital Simulation; Mathematical Models

20070031988 NASA Ames Research Center, Moffett Field, CA, USA

Los Angeles International Airport Runway Incursion Studies: Phase III--Center-Taxiway Simulation

Madson, Michael D.; August 20, 2004; 58 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): 727-04084

Report No.(s): NASA/TM-2004-212807; A-0411047; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031988

Phase III of the Los Angeles International Airport Runway Incursion Studies was conducted, under an agreement with HNTB Corporation, at the NASA Ames FutureFlight Central (FFC) facility in June 2003. The objective of the study was the evaluation of a new center-taxiway concept at LAX. This study is an extension of the Phase I and Phase II studies previously conducted at FFC. This report presents results from Phase III of the study, in which a center-taxiway concept between runways 25L and 25R was simulated and evaluated. Phase III data were compared objectively against the Baseline data. Subjective evaluations by participating LAX controllers were obtained with regard to workload, efficiency, and safety criteria. To facilitate a valid comparison between Baseline and Phase III data, the same scenarios were used for Phase III that were tested during Phases I and II. This required briefing participating controllers on differences in airport and airline operations between 2001 and today.

Author

Airports; Runway Incursions; Simulation; Air Traffic Control; Air Transportation

20070032037 Massachusetts Inst. of Tech., Cambridge, MA, USA; Civil Aerospace Medical Inst., Oklahoma City, OK, USA

Investigating the Use of Color in Timeline Displays

Cummings, M. L.; Tsonis, C.; Xing, J.; August 2007; 19 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): AM-HRRD-522

Report No.(s): DOT/FAA/AM-07/24; No Copyright; Avail.: CASI: A03, Hardcopy

The use of color-coding in human supervisory control displays such as those found in air traffic control is a design intervention meant to mitigate task complexity and reduce mental workload. Color has been shown to aid operators in search and organization tasks; however, it can also cause cognitive tunneling and add to task complexity. This paper details the results from an experiment designed to evaluate increasing color categories in an attempt to objectively measure how the use of color in air traffic control-related displays affects performance. Results showed that the use of six color categories, as compared to three, significantly improved subjects' accuracy in performing search and problem-solving tasks. However, beyond six color categories, performance accuracy was not significantly aided and was possibly degraded. In addition, errors of omission significantly increased when the number of color categories increased from six to nine. This study demonstrated that, especially under high workloads, color categorization beyond six groupings added to overall task complexity as a function of workload, even more than an environmental complexity factor that depends on task requirements.

Author

Air Traffic Control; Color; Color Coding; Display Devices; Workloads (Psychophysiology)

20070032063 NASA Langley Research Center, Hampton, VA, USA

Staging Airliner Service

Hahn, Andrew S.; [2007]; 16 pp.; In English; 7th AIAA Aviation Technology, Integration and Operations Conference (ATIO), 18-20 Sep. 2007, Belfast, Ireland; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 561581.02.08.07.13.04; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032063

There is a general consensus building that historically high fuel prices and greater public awareness of the emissions that result from burning fuel are going to be long-term concerns for those who design, build, and operate airliners. The possibility of saving both fuel and reducing emissions has rekindled interest in breaking very long-range airline flights into multiple stages or even adopting in-flight refueling. It is likely that staging will result in lower fuel burn, and recent published reports have suggested that the savings are substantial, particularly if the airliner is designed from the outset for this kind of operation. Given that staging runs against the design and operation historical trend, this result begs for further attention. This paper will examine the staging question, examining both analytic and numeric performance estimation methodologies to quantify the likely amount of fuel savings that can be expected and the resulting design impacts on the airliner.

Author

Airline Operations; Numerical Analysis; Commercial Aircraft; Services; Air Transportation; Aircraft Design

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

20070031766 NASA Langley Research Center, Hampton, VA, USA
Small Aircraft RF Interference Path Loss
Nguyen, Truong X.; Koppen, Sandra V.; Ely, Jay J.; Szatkowski, George N.; Mielnik, John J.; Salud, Maria Theresa P.; July 08, 2007; 6 pp.; In English; 2007 IEEE International Symposium on Electromagnetic Compatibility, 8-13 July 2007, Honolulu, HI; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Interference to aircraft radio receivers is an increasing concern as more portable electronic devices are allowed onboard. Interference signals are attenuated as they propagate from inside the cabin to aircraft radio antennas mounted on the outside of the aircraft. The attenuation level is referred to as the interference path loss (IPL) value. Significant published IPL data exists for transport and regional category airplanes. This report fills a void by providing data for small business/corporate and general aviation aircraft. In this effort, IPL measurements are performed on ten small aircraft of different designs and manufacturers. Multiple radio systems are addressed. Along with the typical worst-case coupling values, statistical distributions are also reported that could lead to better interference risk assessment.
Author
Radio Frequencies; General Aviation Aircraft; Radio Receivers; Risk

20070031767 NASA Langley Research Center, Hampton, VA, USA
Airborne RF Measurement System and Analysis of Representative Flight RF Environment
Koppen, Sandra V.; Ely, Jay J.; Smith, Laura J.; Jones, Richard A.; Fleck, Vincent J.; Salud, Maria Theresa; Mielnik, John; July 08, 2007; 6 pp.; In English; 2007 IEEE International Symposium on Electromagnetic Compatibility, 8-13 July 2007, Honolulu, HI, USA; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Environmental radio frequency (RF) data over a broad band of frequencies were needed to evaluate the airspace around several airports. An RF signal measurement system was designed using a spectrum analyzer connected to an aircraft VHF/UHF navigation antenna installed on a small aircraft. This paper presents an overview of the RF measurement system and provides analysis of a sample of RF signal measurement data over a frequency range of 30 MHz to 1000 MHz.
Author
Radio Frequencies; Frequency Ranges; Frequency Measurement; Spectrum Analysis; Airspace; Broadband; Navigation

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.

20070032034 Knobbe Martens Olson and Bear, LLP, Irvine, CA, USA
Helicopter Force-Feel and Stability Augmentation System with Parallel Servo-Actuator
Hoh, R. H., Inventor; 11 Aug. 2005; 13 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS2-01029
Patent Info.: Filed 5 Feb. 2004; US-Patent-Appl-SN-10-772-990; US 2005/0173595
Report No.(s): PB2007-104599; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032034

A force-feel system is implemented by mechanically coupling a servo-actuator to and in parallel with a flight control system. The servo-actuator consists of an electric motor, a gearing device, and a clutch. A commanded cockpit-flight-controller position is achieved by pilot actuation of a trim-switch. The position of the cockpit-flight-controller is compared with the commanded position to form a first error which is processed by a shaping function to correlate the first error with a commanded force at the cockpit-flight-controller. The commanded force on the cockpit-flight-controller provides centering

forces and improved control feel for the pilot. In an embodiment, the force-feel system is used as the basic element of stability augmentation system (SAS). The SAS provides a stabilization signal that is compared with the commanded position to form a second error signal. The first error is summed with the second error for processing by the shaping function.
Author
Actuators; Helicopter Control; Helicopters; Servomechanisms; Stability; Stability Augmentation; Flight Control; Flight Management Systems

06
AVIONICS AND AIRCRAFT INSTRUMENTATION

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

20070031755 NASA Langley Research Center, Hampton, VA, USA
Detection of Digital Elevation Model Errors Using X-band Weather Radar
Young, Steven D.; deHaag, Maatren Uijt; January 2007; 18 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NCC1-351; Copyright; Avail.: Other Sources

Flight in Instrument Meteorological Conditions requires pilots to manipulate flight controls while referring to a Primary Flight Display. The Primary Flight Display indicates aircraft attitude along with, in some cases, many other state variables such as altitude, speed, and guidance cues. Synthetic Vision Systems have been proposed that overlay the traditional information provided on Primary Flight Displays onto a scene depicting the location of terrain and other geo-spatial features.Terrain models used by these displays must have sufficient quality to avoid providing misleading information. This paper describes how X-band radar measurements can be used as part of a monitor, and/or maintenance system, to quantify the integrity of terrain models that are used by systems such as Synthetic Vision. Terrain shadowing effects, as seen by the radar, are compared in a statistical manner against estimated shadow feature elements extracted from the stored terrain model from the perspective of the airborne observer. A test statistic is defined that enables detection of errors as small as the range resolution of the radar. Experimental results obtained from two aircraft platforms hosting certified commercial-off-the-shelf X-band radars test the premise and illustrate its potential.
Author
Meteorological Radar; Digital Elevation Models; Attitude (Inclination); Radar Measurement; Display Devices; Flight Instruments; Flight Control

20070031756 NASA Langley Research Center, Hampton, VA, USA
DTED Integrity Monitoring Using Differential GPS and Radar Altimeter
Young, Steve; deHaag, Maarten Uijt; Gray, Robert; [2007]; 10 pp.; In English; IAIN/ION 25th Anniversary Congress in Association with the US ION Annual Meeting, 26-28 Jun. 2000, San Diego, CA, USA; Original contains color illustrations
Contract(s)/Grant(s): NCC1-351; Copyright; Avail.: Other Sources

This paper discusses a real-time digital terrain elevation data (DTED) integrity monitor for Civil Aviation applications. Providing pilots with Synthetic Vision (SV) displays containing terrain information has the potential to improve flight safety by improving situational awareness and thereby reducing the likelihood of Controlled Flight Into Terrain (CFIT). Utilization of the DTED for flight-critical terrain-displays, however, requires a DTED integrity check and timely integrity alerts to the pilots in those cases where DTED may provide hazardous misleading information. The discussed integrity monitor checks the consistency between the sensed terrain profile as computed from DGPS and radar altimeter data and the terrain profile as given by the DTED. Probability of agreement between these two profiles is used to monitor the DTED integrity. A case study to verify the integrity monitor#s performance is presented based on data collected during flight testing performed by NASA at Asheville, NC.
Author
Display Devices; Flight Tests; Real Time Operation; Digital Data; Flight Control; Radio Altimeters; Global Positioning System

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*.

20070032076 NASA Johnson Space Center, Houston, TX, USA

Risk Assessment of Physiological Effects of Atmospheric Composition and Pressure in Constellation Vehicles

Scheuring, Richard A.; Conkin, Johnny; Jones, Jeffrey A.; Gernhardt, Michael L.; [2007]; 33 pp.; In English; 16th International Academy of Astronautics, 20-24 May 2007, Beijing, China; Original contains color illustrations

Report No.(s): Paper OS10-4-HIS 07 A085; Copyright; Avail.: CASI: A03, Hardcopy

To reduce denitrogenation time to prevent decompression sickness to support frequent extravehicular activities on the Moon, and to limit the risk of fire, a hypobaric (P(sub B) = 414 mmHg) and mildly hypoxic (ppO2 = 132 mmHg, 32% O2 - 68% N2) living environment is being considered during lunar missions for the Crew Exploration Vehicle (CEV) and Lunar Surface Access Module (LSAM). If the vehicular ppO2 is acutely changed from 145-178 mmHg at standard vehicular operating pressure to less than 125 mmHg at desired lunar surface outpost operating pressures, there is the possibility that some crewmembers may develop symptoms of Acute Mountain Sickness (AMS). The signs and symptoms of AMS (headache plus nausea, dizziness, fatigue, or sleeplessness), could impact crew health and performance on lunar surface missions. Methods: An exhaustive literature review on the topic of the physiological effects of reduced ppO2 and absolute pressure as may contribute to the development of hypoxia and altitude symptoms or AMS. The results of the nine most rigorous studies were collated, analyzed and contents on the physiological concerns associated with hypobaric operations, AMS and hypoxia symptoms summarized. Results: Although space vehicles have operated in hypobaric conditions previously, they have not operated in a mildly hypoxic ppO2. There is evidence for an absolute pressure effect per se on AMS, such that the higher the altitude for a given hypoxic alveolar O2 partial pressure (P(sub A)O2), the greater the likelihood of an AMS response. About 25% of adults are likely to experience mild AMS near 2,000 m (xxx mmHg) altitude following a rapid ascent from sea level while breathing air (6,500 feet, acute (P(sub A)O2) = 75 mmHg). The operational experience with the Shuttle staged denitrogenation protocol at 528 mmHg (3,048 m) while breathing 26.5% O2 (acute (P(sub A)O2) = 85 mmHg) in astronauts adapting to microgravity suggests a similar likely experience in the proposed CEV environment. Conclusions: We feel that the slightly elevated risk of AMS with the recommended exploration atmospheric parameters is offset by the DCS risk reduction and improved operational efficiency offered by the hypobaric lunar surface vehicular pressure. We believe the risk of mild AMS is greater given a (P(sub A)O2) of 77 mmHg at 4,876 m altitude while breathing 32% O2 than at 1,828 m altitude while breathing 21% O2. Only susceptible astronauts would develop mild and transient AMS with prolonged exposure to 414 mmHg (4,876 m) while breathing 32% O2 (acute (P(sub A)O2) = 77 mmHg). So the following may be employed for operational risk reduction: 1) develop procedures to increase P(sub B) as needed in the CEV, and use a gradual or staged reduction in cabin pressure during lunar outbound; 2) train crews for symptoms of hypoxia, to allow early recognition and consider pre-adaptation of crews to a hypoxic environment prior to launch, 3) consider prophylactic acetazolamide for acute pressure changes and be prepared to treat any AMS associated symptoms early with both carbonic anhydrase inhibitors and supplemental oxygen.

Author

Risk; Spacecraft Environments; Hypoxia; Physiological Effects; Pressure Effects; Spacecraft Cabin Atmospheres; Astronaut Performance

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)*.

20070031903 NASA Johnson Space Center, Houston, TX, USA

Window Observational Research Facility (WORF)

Pelfrey, Joseph; Sledd, Annette; [2007]; 6 pp.; In English; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031903

This viewgraph document concerns the Window Observational Research Facility (WORF) Rack, a unique facility

designed for use with the US Lab Destiny Module window. WORF will provide valuable resources for Earth Science payloads along with serving the purpose of protecting the lab window. The facility can be used for remote sensing instrumentation test and validation in a shirt sleeve environment. WORF will also provide a training platform for crewmembers to do orbital observations of other planetary bodies. WORF payloads will be able to conduct terrestrial studies utilizing the data collected from utilizing WORF and the lab window.
Derived from text
Destiny Laboratory Module; Research Facilities; Spaceborne Experiments

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*.

20070031862 NASA Marshall Space Flight Center, Huntsville, AL, USA
Progress Toward the Stars: An Overview of Ares I First Stage Elements
Williams, Thomas J.; May 2007; 13 pp.; In English; Joint JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031862

This viewgraph presentation reviews the progress made in the development of the Ares The information includes an overview of the Ares Launch Vehicles, progress toward the Preliminary Design Review (PDR), progress on design, development, test, and evaluation and technical progress in the development of the Ares I First Stage subsystem.
CASI
Ares 1 First Stage; Progress; Launchers; Rocket Launchers; Rocket Vehicles

20070031891 NASA Marshall Space Flight Center, Huntsville, AL, USA
Development of the J-2X Engine for the Ares I Crew Launch Vehicle and the Ares V Cargo Launch Vehicle: Building on the Apollo Program for Lunar Return Missions
Greene, William D.; Snoddy, Jim; May 14, 2007; 2 pp.; In English; 54th JPM/3rd LPS/2nd SPS/5th MSS Joint Meeting, 14-17 May 2007, Denver, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

The USA (U.S.) Vision for Space Exploration has directed NASA to develop two new launch vehicles for sending humans to the Moon, Mars, and beyond. In January 2006, NASA streamlined its hardware development approach for replacing the Space Shuttle after it is retired in 2010. Benefits of this approach include reduced programmatic and technical risks and the potential to return to the Moon by 2020, by developing the Ares I Crew Launch Vehicle (CLV) propulsion elements now, with full extensibility to future Ares V Cargo Launch Vehicle (CaLV) lunar systems. The Constellation Program selected the Pratt & Whitney Rocketdyne J-2X engine to power the Ares I Upper Stage Element and the Ares V Earth Departure Stage. This decision was reached during the Exploration Systems Architecture Study and confirmed after the Exploration Launch Projects Office performed a variety of risk analyses, commonality assessments, and trade studies. This paper narrates the evolution of that decision; describes the performance capabilities expected of the J-2X design, including potential commonality challenges and opportunities between the Ares I and Ares V launch vehicles; and provides a current status of J-2X design, development, and hardware testing activities. This paper also explains how the J-2X engine effort mitigates risk by testing existing engine hardware and designs; building on the Apollo Program (1961 to 1975), the Space Shuttle Program (1972 to 2010); and consulting with Apollo-era experts to derive other lessons lived to deliver a human-rated engine that is on an aggressive development schedule, with its first demonstration flight in 2012.
Author
Launch Vehicles; Ares 1 Launch Vehicle; Ares 5 Cargo Launch Vehicle; Space Exploration; Launching; Engine Design

20070031958 NASA Marshall Space Flight Center, Huntsville, AL, USA
Design for Reliability and Safety Approach for the NASA New Launch Vehicle
Safie, Fayssal, M.; Weldon, Danny M.; May 14, 2007; 1 pp.; In English; 2nd IAASS Conference: Space Safety in a Global World, 14-17 May 2007, Chicago, IL, USA; No Copyright; Avail.: Other Sources; Abstract Only

The USA National Aeronautics and Space Administration (NASA) is in the midst of a space exploration program intended for sending crew and cargo to the international Space Station (ISS), to the moon, and beyond. This program is called Constellation. As part of the Constellation program, NASA is developing new launch vehicles aimed at significantly increase

safety and reliability, reduce the cost of accessing space, and provide a growth path for manned space exploration. Achieving these goals requires a rigorous process that addresses reliability, safety, and cost upfront and throughout all the phases of the life cycle of the program. This paper discusses the 'Design for Reliability and Safety' approach for the NASA new crew launch vehicle called ARES I. The ARES I is being developed by NASA Marshall Space Flight Center (MSFC) in support of the Constellation program. The ARES I consists of three major Elements: A solid First Stage (FS), an Upper Stage (US), and liquid Upper Stage Engine (USE). Stacked on top of the ARES I is the Crew exploration vehicle (CEV). The CEV consists of a Launch Abort System (LAS), Crew Module (CM), Service Module (SM), and a Spacecraft Adapter (SA). The CEV development is being led by NASA Johnson Space Center (JSC). Designing for high reliability and safety require a good integrated working environment and a sound technical design approach. The 'Design for Reliability and Safety' approach addressed in this paper discusses both the environment and the technical process put in place to support the ARES I design. To address the integrated working environment, the ARES I project office has established a risk based design group called 'Operability Design and Analysis' (OD&A) group. This group is an integrated group intended to bring together the engineering, design, and safety organizations together to optimize the system design for safety, reliability, and cost. On the technical side, the ARES I project has, through the OD&A environment, implemented a probabilistic approach to analyze and evaluate design uncertainties and understand their impact on safety, reliability, and cost. This paper focuses on the use of the various probabilistic approaches that have been pursued by the ARES I project. Specifically, the paper discusses an integrated functional probabilistic analysis approach that addresses upffont some key areas to support the ARES I Design Analysis Cycle (DAC) pre Preliminary Design (PD) Phase. This functional approach is a probabilistic physics based approach that combines failure probabilities with system dynamics and engineering failure impact models to identify key system risk drivers and potential system design requirements. The paper also discusses other probabilistic risk assessment approaches planned by the ARES I project to support the PD phase and beyond.
Author
Reliability Analysis; Constellation Program; International Space Station; Aerospace Safety; Ares 1 Launch Vehicle; Launch Vehicle Configurations

20070031996 NASA Marshall Space Flight Center, Huntsville, AL, USA
Ares V: Designing the Heavy Lift Capability to Explore the Moon
Sumrall, John P.; McArthur, Craig; [2007]; 3 pp.; In English; AIAA Space 2007 Conference and Exposition, 18-20 Sep. 2007, Long Beach, CA, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031996

NASA's Vision for Exploration requires a safe, efficient, reliable, and versatile launch vehicle capable ofplacing large payloads into Earth orbit for transfer to the Moon and destinations beyond. The Ares V Cargo Launch Vehicle (CaLV) will provide this heavy lift capability. The Ares V launch concept is shown. When it stands on the launch pad at Kennedy Space Center late in the next decade, the Ares V stack will be almost 360 feet fall. As currently envisioned, it will lift 136 metric tons (300,000 pounds) to a 30-by-160 nautical mile orbit at 28.5-degrees inclination, or 55 metric tons (120,000 pounds) to trans-lunar injection. This paper will cover the latest developments in the Ares V project in 2007 and discuss future activities.
Author
Ares 5 Cargo Launch Vehicle; Moon; Lunar Exploration; NASA Space Programs; Rocket Engine Design

20070031997 NASA Marshall Space Flight Center, Huntsville, AL, USA
Launching to the Moon, Mars, and Beyond
Sumrall, John P.; [2007]; 2 pp.; In English; Iowa Academy of Sciences Annual Meeting, 27-29 Apr. 2007, Pella, IA, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031997

America is returning to the Moon in preparation for the first human footprint on Mars, guided by the U.S. Vision for Space Exploration. This presentation will discuss NASA's mission today, the reasons for returning to the Moon and going to Mars, and how NASA will accomplish that mission. The primary goals of the Vision for Space Exploration are to finish the International Space Station, retire the Space Shuttle, and build the new spacecraft needed to return people to the Moon and go to Mars. Unlike the Apollo program of the 1960s, this phase of exploration will be a journey, not a race. In 1966, the NASA's budget was 4 percent of federal spending. Today, with 6/10 of 1 percent of the budget, NASA must incrementally develop the vehicles, infrastructure, technology, and organization to accomplish this goal. Fortunately, our knowledge and experience are greater than they were 40 years ago. NASA's goal is a return to the Moon by 2020. The Moon is the first step to America's exploration of Mars. Many questions about the Moon's history and how its history is linked to that of Earth remain even after the brief Apollo explorations of the 1960s and 1970s. This new venture will carry more explorers to more

diverse landing sites with more capable tools and equipment. The Moon also will serve as a training ground in several respects before embarking on the longer, more perilous trip to Mars. The journeys to the Moon and Mars will require a variety of vehicles, including the Ares I Crew Launch Vehicle, the Ares V Cargo Launch Vehicle, the Orion Crew Exploration Vehicle, and the Lunar Surface Access Module. The architecture for the lunar missions will use one launch to ferry the crew into orbit on the Ares I and a second launch to orbit the lunar lander and the Earth Departure Stage to send the lander and crew vehicle to the Moon. In order to reach the Moon and Mars within a lifetime and within budget, NASA is building on proven hardware and decades of experience derived from the Apollo Saturn, Space Shuttle, and contemporary commercial launch vehicle programs. Less than one year after the Exploration Launch Projects Office was formed at NASA's Marshall Space Flight Center, engineers are testing engine components, firing test rocket motors, refining vehicle designs in wind tunnel tests, and building hardware for the first flight test of Ares I, scheduled for spring 2009. The Vision for Exploration will require this nation to develop tools, machines, materials, and processes never before invented, technologies and capabilities that can be turned over to the private sector to benefit nearly all aspects of life on Earth. This new pioneering venture, as did the Apollo Program before it, will contribute to America's economic leadership, national security, and technological global competitiveness and serve as an inspiration for all its citizens.

Author

Moon; Mars Exploration; Spacecraft Launching; Ares 1 Launch Vehicle; Ares 5 Cargo Launch Vehicle; Crew Exploration Vehicle; Manned Space Flight

20070032031 NASA Marshall Space Flight Center, Huntsville, AL, USA

Analytical Approach for Estimating Preliminary Mass of ARES I Crew Launch Vehicle Upper Stage Structural Components

Aggarwal, Pravin; April 23, 2007; 4 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Mterials Conference, 23-26 Apr. 2007, Honolulu, HI, USA; No Copyright; Avail.: Other Sources; Abstract Only

In January 2004, President Bush gave the National Aeronautics and Space Administration (NASA) a vision for Space Exploration by setting our sight on a bold new path to go back to the Moon, then to Mars and beyond. In response to this vision, NASA started the Constellation Program, which is a new exploration launch vehicle program. The primary mission for the Constellation Program is to carry out a series of human expeditions ranging from Low Earth Orbit to the surface of Mars and beyond for the purposes of conducting human exploration of space, as specified by the Vision for Space Exploration (VSE). The intent is that the information and technology developed by this program will provide the foundation for broader exploration activities as our operational experience grows. The ARES I Crew Launch Vehicle (CLV) has been designated as the launch vehicle that will be developed as a 'first step' to facilitate the aforementioned human expeditions. The CLV Project is broken into four major elements: First Stage, Upper Stage Engine, Upper Stage (US), and the Crew Exploration Vehicle (CEV). NASA's Marshall Space Flight Center (MSFC) is responsible for the design of the CLV and has the prime responsibility to design the upper stage of the vehicle. The US is the second propulsive stage of the CLV and provides CEV insertion into low Earth orbit (LEO) after separation from the First Stage of the Crew Launch Vehicle. The fully integrated Upper Stage is a mix of modified existing heritage hardware (J-2X Engine) and new development (primary structure, subsystems, and avionics). The Upper Stage assembly is a structurally stabilized cylindrical structure, which is powered by a single J-2X engine which is developed as a separate Element of the CLV. The primary structure includes the load bearing liquid hydrogen (LH2) and liquid oxygen (LOX) propellant tanks, a Forward Skirt, the Intertank structure, the Aft Skirt and the Thrust Structure. A Systems Tunnel, which carries fluid and electrical power functions to other Elements of the CLV, is included as secondary structure. The MSFC has an overall responsibility for the integrated US element as well as structural design an thermal control of the fuel tanks, intertank, interstage, avionics, main propulsion system, Reaction Control System (RCS) for both the Upper Stage and the First Stage. MSFC's Spacecraft and Vehicle Department, Structural and Analysis Design Division is developing a set of predicted mass of these elements. This paper details the methodology, criterion and tools used for the preliminary mass predictions of the upper stage structural assembly components. In general, weight of the cylindrical barrel sections are estimated using the commercial code Hypersizer, whereas, weight of the domes are developed using classical solutions. HyperSizer is software that performs automated structural analysis and sizing optimization based on aerospace methods for strength, stability, and stiffness. Analysis methods range from closed form, traditional hand calculations repeated every day in industry to more advanced panel buckling algorithms. Margin-of-safety reporting for every potential failure provides the engineer with a powerful insight into the structural problem. Optimization capabilities include finding minimum weight panel or beam concepts, material selections, cross sectional dimensions, thicknesses, and lay-ups from a library of 40 different stiffened and sandwich designs and a database of composite, metallic, honeycomb, and foam materials. Multiple different concepts (orthogrid, isogrid, and skin stiffener) were run for multiple loading combinations of ascent design load with and with out tank pressure as well as proof pressure condition. Subsequently, selected optimized concept obtained

from Hypersizer runs was translated into a computer aid design (CAD) model to account for the wall thickness tolerance, weld land etc for developing the most probable weight of the components. The flow diram summarizes the analysis steps used in developing these predicted mass.
Author
Ares 1 Launch Vehicle; Structural Analysis; Structural Design; Crew Exploration Vehicle; Structural Weight; Weight Analysis

20070032038 NASA Marshall Space Flight Center, Huntsville, AL, USA
Space Shuttle Propulsion Systems Plume Modeling and Simulation for the Lift-Off Computational Fluid Dynamics Model
Strutzenberg, L. L.; Dougherty, N. S.; Liever, P. A.; West, J. S.; Smith, S. D.; May 14, 2007; 16 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Original contains color illustrations
Contract(s)/Grant(s): NNM05AB50C; Copyright; Avail.: CASI: A03, Hardcopy

This paper details advances being made in the development of Reynolds-Averaged Navier-Stokes numerical simulation tools, models, and methods for the integrated Space Shuttle Vehicle at launch. The conceptual model and modeling approach described includes the development of multiple computational models to appropriately analyze the potential debris transport for critical debris sources at Lift-Off. The conceptual model described herein involves the integration of propulsion analysis for the nozzle/plume flow with the overall 3D vehicle flowfield at Lift-Off. Debris Transport Analyses are being performed using the Shuttle Lift-Off models to assess the risk to the vehicle from Lift-Off debris and appropriately prioritized mitigation of potential debris sources to continue to reduce vehicle risk. These integrated simulations are being used to evaluate plume-induced debris environments where the multi-plume interactions with the launch facility can potentially accelerate debris particles toward the vehicle.
Author
Computational Fluid Dynamics; Computerized Simulation; Mathematical Models; Space Shuttles; Spacecraft Launching; Debris; Propulsion System Performance

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*.

20070031806 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Sample Return Primer and Handbook
Barrow, Kirk; Cheuvront, Allan; Faris, Grant; Hirst, Edward; Mainland, Nora; McGee, Michael; Szalai, Christine; Vellinga, Joseph; Wahl, Thomas; Williams, Kenneth; Lee, Gentry; Duxbury, Thomas; January 2007; 178 pp.; In English; Original contains color and black and white illustrations
Report No.(s): JPL D-37294; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40174

This three-part Sample Return Primer and Handbook provides a road map for conducting the terminal phase of a sample return mission. The main chapters describe element-by-element analyses and trade studies, as well as required operations plans, procedures, contingencies, interfaces, and corresponding documentation. Based on the experiences of the lead Stardust engineers, the topics include systems engineering (in particular range safety compliance), mission design and navigation, spacecraft hardware and entry, descent, and landing certification, flight and recovery operations, mission assurance and system safety, test and training, and the very important interactions with external support organizations (non-NASA tracking assets, landing site support, and science curation).
Author
Handbooks; Sample Return Missions; Stardust Mission; Mission Planning; Flight Operations; Certification; Systems Engineering

20070031902 NASA Johnson Space Center, Houston, TX, USA
STS 118 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-118) and International Space Station
James, John T.; [2007]; 1 pp.; In English; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031902

The toxicological assessments of 2 grab sample canisters (GSCs) and one pair of formaldehyde badges from the Shuttle

are reported. Analytical methods have not changed from earlier reports. The recoveries of the 3 surrogates (C-13-acetone, fluorobenzene, and chlorobenzene) from the 2 GSCs averaged 120, 117, and 122 %, respectively. Three formaldehyde controls averaged 98% recovery. The Shuttle atmosphere was acceptable for human respiration. The toxicological assessment of 8 GSCs and 6 pairs of formaldehyde badges from the ISS is shown. The recoveries of the 3 standards (as listed above) from the GSCs averaged 99, 99 and 99%, respectively. Three formaldehyde control badges averaged 98% recovery. Based on these limited samples, the ISS atmosphere is acceptable for human respiration. The alcohol levels were well controlled throughout the period of sampling.
Author
Air Quality; International Space Station; Space Transportation System; Space Shuttles; Toxicology; Carbon 13; Sample Return Missions

20070031927 NASA Langley Research Center, Hampton, VA, USA
A Return to Innovative Engineering Design, Critical Thinking and Systems Engineering
Camarda, Charles J.; June 27, 2007; 44 pp.; In English; 29th International Thermal Conductivity Conference (ITCC), 24-27 Jun. 2007, Birmingham, AL, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 510505.01.07.01.06; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031927

I believe we are facing a critical time where innovative engineering design is of paramount importance to the success of our aerospace industry. However, the very qualities and attributes necessary for enhancing, educating, and mentoring a creative spirit are in decline in important areas. The importance of creativity and innovation in this country was emphasized by a special edition of the Harvard Business Review OnPoint entitled: 'The Creative Company' which compiled a series of past and present articles on the subject of creativity and innovation and stressed its importance to our national economy. There is also a recognition of a lack of engineering, critical thinking and problem-solving skills in our education systems and a trend toward trying to enhance those skills by developing K-12 educational programs such as Project Lead the Way, 'Science for All Americans', Benchmarks 2061 , etc. In addition, with respect to spacecraft development, we have a growing need for young to mid-level engineers with appropriate experience and skills in spacecraft design, development, analysis, testing, and systems engineering. As the Director of Engineering at NASA's Johnson Space Center, I realized that sustaining engineering support of an operational human spacecraft such as the Space Shuttle is decidedly different than engineering design and development skills necessary for designing a new spacecraft such as the Crew Exploration Vehicle of the Constellation Program. We learned a very important lesson post Columbia in that the Space Shuttle is truly an experimental and not an operational vehicle and the strict adherence to developed rules and processes and chains of command of an inherently bureaucratic organizational structure will not protect us from a host of known unknowns let alone unknown unknowns. There are no strict rules, processes, or procedures for understanding anomalous results of an experiment, anomalies with an experimental spacecraft like Shuttle, or in the conceptual design of a spacecraft. Engineering design is as much an art as it is a science. The critical thinking skills necessary to uncover lurking problems in an experimental design and creatively develop solutions are some of the same skills necessary to design a new spacecraft. Thus, I believe engineers unfamiliar with or removed from design and development need time to transition and develop the required skill set to be effective spacecraft designers. I believe the creative process necessary in design can be enhanced and even taught as early as grades K-12 and should continue to be nurtured and developed at the university level and beyond. I am going to present a strategy for developing learning teams to address complex multidisciplinary problems and to creatively develop solutions to those problems rapidly at minimal cost. I will frame a real problem, the development of on-orbit thermal protection system repair of the Space Shuttle, and step through the series of skills necessary to enhance the creative process. The case study I will illustrate is based on a real project, the R&D Reinforced Carbon-Carbon (RCC) Repair Team's development of on-orbit repair concepts for damaged Space Shuttle RCC nose cap and/or leading edges.
Author
Systems Engineering; Space Shuttles; Carbon-Carbon Composites; Computational Fluid Dynamics; Spacecraft Maintenance

20070031969 NASA Marshall Space Flight Center, Huntsville, AL, USA
Comparison of Focused and Near-Field Imaging of Spray on Foam Insulation (SOFI) at Millimeter Wave Frequencies
Kharkovshy, S.; Zoughi, R.; Hepburn, F. L.; June 27, 2007; 6 pp.; In English; 3rd International Conference on Electromagnetic Near-Field Characterization and Imaging (ICONIC 2007), 27-29 Jun. 2007, Saint Louis, MO, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM06AA06G; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031969

Millimeter wave imaging techniques can provide high spatial-resolution images of various composites. Lens antennas

may be incorporated into the imaging system to provide a small incident beam footprint. Another approach may involve the use of horn antennas, which if operating in their near-fields, images with reasonably high spatial-resolutions may also be obtained. This paper gives a comparison between such near-field and focused far-field imaging of the Space Shuttle Spray on Foam Insulation (SOFI) used in its external fuel tank at millimeter wave frequencies. Small horn antennas and lens antennas with relatively long depth of focus were used in this investigation.
Author
Imaging Techniques; Insulation; Foams; External Tanks; Space Shuttles; Millimeter Waves; High Resolution; Near Fields; Far Fields

20070032677 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Landing and Population Hazard Analysis for Stardust Entry in Operations and Entry Planning
Tooley, Jeffrey; Desai, Prasun N.; Lynos, Daniel T.; Hirst, Edward A.; Wahl, Tom E.; Wawrzyniak, Georffery G.; August 20, 2006; 7 pp.; In English; AIAA/AAS Astrodynamics Specialist Conference, 20-25 Aug. 2006, Keystone, Co, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40218

Stardust is a comet sample return mission that successfully returned to Earth on January 15, 2006. Stardust's targeted landing area was the Utah Test and Training Range in the Northwest corner of Utah. Requirements for the risks associated with landing were levied on Stardust by the Utah Test and Training Range and NASA. This paper describes the analysis to verify that these requirements were met and and includes calculation of debris survivability, generation of landing site selection plots, and identification of keep-out zones, as well as appropriate selection of the landing site. Operationally the risk requirements were all met for both of the GOMO-GO polls, so entry was authorized.
Author
Stardust Mission; Sample Return Missions; Risk; Landing Sites; Flyby Missions; Hazards

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*.

20070031757 NASA Langley Research Center, Hampton, VA, USA
Physiological Self-Regulation and Adaptive Automation
Prinzell, Lawrence J.; Pope, Alan T.; Freeman, Frederick G.; [2007]; 18 pp.; In English
Contract(s)/Grant(s): RTA 548-50-21; Copyright; Avail.: Other Sources

Adaptive automation has been proposed as a solution to current problems of human-automation interaction. Past research has shown the potential of this advanced form of automation to enhance pilot engagement and lower cognitive workload. However, there have been concerns voiced regarding issues, such as automation surprises, associated with the use of adaptive automation. This study examined the use of psychophysiological self-regulation training with adaptive automation that may help pilots deal with these problems through the enhancement of cognitive resource management skills. Eighteen participants were assigned to 3 groups (self-regulation training, false feedback, and control) and performed resource management, monitoring, and tracking tasks from the Multiple Attribute Task Battery. The tracking task was cycled between 3 levels of task difficulty (automatic, adaptive aiding, manual) on the basis of the electroencephalogram-derived engagement index. The other two tasks remained in automatic mode that had a single automation failure. Those participants who had received self-regulation training performed significantly better and reported lower National Aeronautics and Space Administration Task Load Index scores than participants in the false feedback and control groups. The theoretical and practical implications of these results for adaptive automation are discussed.
Author
Workloads (Psychophysiology); Automatic Control; Psychophysiology; NASA Programs; Electroencephalography; Feedback Control

20070031878 American Inst. of Aeronautics and Astronautics, Reston, VA, USA

LEO Mobiles: The Next Generation

Aerospace America; June 2007; ISSN 0740-722X, pp. 18-20; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

This article reviews the advances of commercial use of Low Earth Orbit (LEO) for communication satellites. The satellites, Irridiums, Globalstars, and Orbcomm (Orbital Communications), have served and will continue to serve for several years beyond their expected service lifes. The article reviews the plans of the major communications satellite manufacturers for replenishing their fleet.

CASI

Communication Satellites; Low Earth Orbits; Service Life; Wireless Communication

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*.

20070031760 NASA Langley Research Center, Hampton, VA, USA

Analysis of Eddy Current Capabilities for the Detection of Outer Diameter Stress Corrosion Cracking in Small Bore Metallic Structures

Wincheski, Buzz; Williams, Phillip; Simpson, John; [2007]; 9 pp.; In English; 34th Annual Review of Progress in Quantitative Nondestructive Evaluation (QNDE 2007), 22-27 Jul. 2007, Golden, CO, USA

Contract(s)/Grant(s): WBS 732759.07.13; Copyright; Avail.: CASI: A02, Hardcopy

The use of eddy current techniques for the detection of outer diameter damage in tubing and many complex aerospace structures often requires the use of an inner diameter probe due to a lack of access to the outside of the part. In small bore structures the probe size and orientation are constrained by the inner diameter of the part, complicating the optimization of the inspection technique. Detection of flaws through a significant remaining wall thickness becomes limited not only by the standard depth of penetration, but also geometrical aspects of the probe. Recently, an orthogonal eddy current probe was developed for detection of such flaws in Space Shuttle Primary Reaction Control System (PRCS) Thrusters. In this case, the detection of deeply buried stress corrosion cracking by an inner diameter eddy current probe was sought. Probe optimization was performed based upon the limiting spatial dimensions, flaw orientation, and required detection sensitivity. Analysis of the probe/flaw interaction was performed through the use of finite and boundary element modeling techniques. Experimental data for the flaw detection capabilities, including a probability of detection study, will be presented along with the simulation data. The results of this work have led to the successful deployment of an inspection system for the detection of stress corrosion cracking in Space Shuttle Primary Reaction Control System (PRCS) Thrusters.

Author

Eddy Currents; Nondestructive Tests; Damage; Aircraft Structures; Detection; Stress Corrosion Cracking

20070031761 NASA Langley Research Center, Hampton, VA, USA

Crew Exploration Vehicle Launch Abort Controller Performance Analysis

Sparks, Dean W., Jr.; Raney, David L.; August 20, 2007; 22 pp.; In English; AIAA Guidance, Navigation, and Control Conference & Exhibit, 20-23 August 2007, Hilton Head, SC, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031761

This paper covers the simulation and evaluation of a controller design for the Crew Module (CM) Launch Abort System (LAS), to measure its ability to meet the abort performance requirements. The controller used in this study is a hybrid design, including features developed by the Government and the Contractor. Testing is done using two separate 6-degree-of-freedom (DOF) computer simulation implementations of the LAS/CM throughout the ascent trajectory: 1) executing a series of abort simulations along a nominal trajectory for the nominal LAS/CM system; and 2) using a series of Monte Carlo runs with perturbed initial flight conditions and perturbed system parameters. The performance of the controller is evaluated against a

set of criteria, which is based upon the current functional requirements of the LAS. Preliminary analysis indicates that the performance of the present controller meets (with the exception of a few cases) the evaluation criteria mentioned above.
Author
Monte Carlo Method; Flight Conditions; Launching; Spacecraft Modules; Reliability Analysis; Functional Design Specifications; Spacecrews; Controllers

20070031781 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Preliminary Analysis of the 30-m UltraBoom Flight Test
Agnes, Gregory S.; Abelson, Robert D.; Miyake, Robert; Lin, John K. H.; Welsh, Joe; Watson, Judith J.; April 18, 2005; 7 pp.; In English; 46th Structural Dynamics and Materiels Conference, 18-21 Apr. 2005, Austin, TX; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40204

Future NASA missions require long, ultra-lightweight booms to enable solar sails, large sunshields, and other gossamer-type spacecraft structures. The space experiment discussed in this paper will flight validate the non-traditional ultra lightweight rigidizable, inflatable, isogrid structure utilizing graphite shape memory polymer (GR/SMP) called UltraBoom(TradeMark). The focus of this paper is the analysis of the 3-m ground test article. The primary objective of the mission is to show that a combination of ground testing and analysis can predict the on-orbit performance of an ultra lightweight boom that is scalable, predictable, and thermomechanically stable.
Author
Spacecraft Structures; Inflatable Structures; NASA Programs; Performance Prediction; Solar Sails; Spaceborne Experiments

20070031869 NASA Marshall Space Flight Center, Huntsville, AL, USA
Aerocapture Inflatable Decelerator for Planetary Entry
Reza, Sajjad; Hund, Richard; Kustas, Frank; Willcockson, William; Songer, Jarvis; Brown, Glen; May 21, 2007; 18 pp.; In English; 19th AIAA Aerodynamic Decelerator Systems Technology Conference, 21-24 May 2007, Williamsburg, VA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM04AB53C; Copyright; Avail.: CASI: A03, Hardcopy

Forward Attached Inflatable Decelerators, more commonly known as inflatable aeroshells, provide an effective, cost efficient means of decelerating spacecrafts by using atmospheric drag for aerocapture or planetary entry instead of conventional liquid propulsion deceleration systems. Entry into planetary atmospheres results in significant heating and aerodynamic pressures which stress aeroshell systems to their useful limits. Incorporation of lightweight inflatable decelerator surfaces with increased surface-area footprints provides the opportunity to reduce heat flux and induced temperatures, while increasing the payload mass fraction. Furthermore, inflatable aeroshell decelerators provide the needed deceleration at considerably higher altitudes and Mach numbers when compared with conventional rigid aeroshell entry systems. Inflatable aeroshells also provide for stowage in a compact space, with subsequent deployment of a large-area, lightweight heatshield to survive entry heating. Use of a deployable heatshield decelerator enables an increase in the spacecraft payload mass fraction and may eliminate the need for a spacecraft backshell.
Author
Aerocapture; Aerodynamic Brakes; Deceleration; Brakes (For Arresting Motion); Atmospheric Entry; Inflatable Structures

20070031883 NASA Marshall Space Flight Center, Huntsville, AL, USA
Automated Rendezvous and Docking Sensor Testing at the Flight Robotics Laboratory
Howard, Richard T.; Williamson, Marlin L.; Johnston, Albert S.; Brewster, Linda L.; Mitchell, Jennifer D.; Cryan, Scott P.; Strack, David; Key, Kevin; [2007]; 12 pp.; In English; SPIE Defense and Security Symposium, 9-13 Apr. 2007, Orlando, FL, USA; Copyright; Avail.: CASI: A03, Hardcopy

The Exploration Systems Architecture defines missions that require rendezvous, proximity operations, and docking (RPOD) of two spacecraft both in Low Earth Orbit (LEO) and in Low Lunar Orbit (LLO). Uncrewed spacecraft must perform automated and/or autonomous rendezvous, proximity operations and docking operations (commonly known as Automated Rendezvous and Docking, (AR&D).) The crewed versions of the spacecraft may also perform AR&D, possibly with a different level of automation and/or autonomy, and must also provide the crew with relative navigation information for manual piloting. The capabilities of the RPOD sensors are critical to the success of the Exploration Program. NASA has the responsibility to determine whether the Crew Exploration Vehicle (CEV) contractor-proposed relative navigation sensor suite will meet the CEV requirements. The relatively low technology readiness of relative navigation sensors for AR&D has been carried as one

of the CEV Projects top risks. The AR&D Sensor Technology Project seeks to reduce this risk by increasing technology maturation of selected relative navigation sensor technologies through testing and simulation, and to allow the CEV Project to assess the relative navigation sensors.
Author
Spacecraft Docking; Flight Tests; Low Earth Orbits; Orbital Rendezvous; Robotics; Navigation Instruments

20070031899 NASA Johnson Space Center, Houston, TX, USA
HSI in Human Spaceflight
Baggerman, Susan D.; March 21, 2007; 13 pp.; In English; Human Systems Integration Symposium 2007, 19-21 Mar. 2007, Annapolis, MD, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031899

This viewgraph document examines the scope of Human Systems Integration (HSI) at NASA, and the implementation of HSI in the human space flight programs. Two areas of interest are the Responsibilities and the lessons learned from the International Space Station and the strategy and approach for the Crew Exploration Vehicle.
CASI
Space Flight; Systems Integration; Manned Space Flight; Human Factors Engineering; Man Machine Systems

20070031955 NASA Marshall Space Flight Center, Huntsville, AL, USA
Application of Vacuum Swing Adsorption for Carbon Dioxide and Water Vapor Removal from Manned Spacecraft Atmospheres
Knox, J.; Fulda, P.; Howard, D.; Ritter, J.; Levan, M.; May 21, 2007; 1 pp.; In English; Fundamentals of Adsorption/AIDIC Servizi, S.r.l., 21-25 May 2007, Sicily, Italy; Copyright; Avail.: Other Sources; Abstract Only

The design and testing of a vacuum-swing adsorption process to remove metabolic ‘water and carbon dioxide gases from NASA’s Orion crew exploration vehicle atmosphere is presented. For the Orion spacecraft, the sorbent-based atmosphere revitalization (SBAR) system must remove all metabolic water, a technology approach 1Lhathas not been used in previous spacecraft life support systems. Design and testing of a prototype SBAR in sub-scale and full-scale configurations is discussed. Experimental and analytical investigations of dual-ended and single-ended vacuum desorption are presented. An experimental investigation of thermal linking between adsorbing and desorbing columns is also presented.
Author
Carbon Dioxide; Manned Spacecraft; Water Vapor; Vacuum Tests; Mechanical Engineering

20070031992 Lockheed Martin Space Systems Co., Huntsville, AL, USA; NASA Marshall Space Flight Center, Huntsville, AL, USA
Aerocapture Inflatable Decelerator (AID)
Reza, Sajjad; May 23, 2007; 32 pp.; In English; 19th AIAA Aerodynamic Decelerator Systems Technology Conference, 21-24 May 2007, Williamsburg, VA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM04AB53C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031992

Forward Attached Inflatable Decelerators, more commonly known as inflatable aeroshells, provide an effective, cost efficient means of decelerating spacecrafts by using atmospheric drag for aerocapture or planetary entry instead of conventional liquid propulsion deceleration systems. Entry into planetary atmospheres results in significant heating and aerodynamic pressures which stress aeroshell systems to their useful limits. Incorporation of lightweight inflatable decelerator surfaces with increased surface-area footprints provides the opportunity to reduce heat flux and induced temperatures, while increasing the payload mass fraction. Furthermore, inflatable aeroshell decelerators provide the needed deceleration at considerably higher altitudes and Mach numbers when compared with conventional rigid aeroshell entry systems. Inflatable aeroshells also provide for stowage in a compact space, with subsequent deployment of a large-area, lightweight heatshield to survive entry heating. Use of a deployable heatshield decelerator not only enables an increase in the spacecraft payload mass fraction and but may also eliminate the need for a spacecraft backshell and cruise stage. This document is the viewgraph slides for the paper’s presentation.
Author
Aerocapture; Aerodynamic Brakes; Aerodynamic Drag; Aeroshells; Deceleration; Inflatable Structures; Heat Shielding; Spacecraft Landing

20070032008 NASA Marshall Space Flight Center, Huntsville, AL, USA

Updated Heliostorm Warning Mission: Enhancements Based on New Technology

Young, Roy M.; [2007]; 11 pp.; In English; 2nd Spacecraft Propulsion Subcommittee Meeting at the 54th JANNAF Joint Prouplsion Meeting, 12-17 May 2007, Denver, CO, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NAS8-03046; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032008

The Heliostorm (also referred to as Geostorm) mission has been regarded as the best choice for the first application of solar sail technology. The objective of Heliostorm is to obtain data from an orbit station slightly displaced from the ecliptic at or nearer to the Sun than 0.98 AU, which places it twice as close to the sun as Earth's natural L1 point at 0.993 AU. The maintenance of such an orbit location would require prohibitive amounts of propellants using chemical or electric propulsion systems; however, a solar sailcraft is ideally suited for this purpose because it relies solely on the propulsive force from photons for orbit maintenance. Heliostorm has been the subject of several mission studies over the past decade, with the most complete study conducted in 1999 in conjunction with a proposed New Millennium Program (NMP) Space Technology 5 (ST-5) flight opportunity. Recently, over a two and one-half year period dating from 2003 through 2005, NASA's In-Space Propulsion Technology Program (ISTP) matured solar sail technology from laboratory components to full systems, demonstrated in as relevant a space environment as could feasibly be simulated on the ground. Work under this program has yielded promising results for enhanced Heliostorm mission performance. This enhanced performance is achievable principally through reductions in the sail areal density. These reductions are realized through the use of lower linear mass density booms, a thinner sail membrane, and increased sail area. Advancements in sailcraft vehicle system design also offer potential mass reductions and hence improved performance. This paper will present the preliminary results of an updated Heliostorm mission design study including the enhancements incorporated during the design, development, analysis and testing of the system ground demonstrator.

Author

Solar Sails; Technology Utilization; Space Missions; Spacecraft Design; Sun; Heliosphere

20070032012 NASA Marshall Space Flight Center, Huntsville, AL, USA

TRL Assessment of Solar Sail Technology Development Following the 20-Meter System Ground Demonstrator Hardware Testing

Montgomery, Edward E.; Young, Roy M.; Adams, Charles L.; May 14, 2007; 11 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NNM05AB50C; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032012

The NASA In-Space Propulsion Technology (ISPT) Projects Office has been sponsoring 2 separate, independent system design and development hardware demonstration activities during 2002-2005. ATK Space Systems of Goleta, CA was the prime contractor for one development team and L'Garde, Inc. of Tustin, CA was the prime contractor for the other development team. The goal of these activities was to advance the technology readiness level (TRL) of solar sail propulsion from 3 towards 6 by the year 2006. Component and subsystem fabrication and testing were completed successfully, including the ground deployment of 10-meter and 20-meter ground demonstration hardware systems under vacuum conditions. The deployment and structural testing of the 20-meter solar sail systems was conducted in the 30 meter diameter Space Power Facility thermal-vacuum chamber at NASA Glenn Plum Brook in April though August, 2005. This paper will present the results of the TRL assessment following the solar sail technology development activities associated with the design, development, analysis and testing of the 20-meter system ground demonstrators. Descriptions of the system designs for both the ATK and L'Garde systems will be presented. Changes, additions and evolution of the system designs will be highlighted. A description of the modeling and analyses activities performed by both teams, as well as testing conducted to raise the TRL of solar sail technology will be presented. A summary of the results of model correlation activities will be presented. Finally, technology gaps identified during the assessment and gap closure plans will be presented, along with 'lessons learned', subsequent planning activities and validation flight opportunities for solar sail propulsion technology.

Author

Solar Sails; Technology Assessment; Hardware; Aerospace Systems; Systems Analysis; Ground Tests

20070032064 NASA Marshall Space Flight Center, Huntsville, AL, USA
Adaptive Control of Truss Structures for Gossamer Spacecraft
Yang Bong-Jun; Calise, anthony J.; Craig, James I.; Whorton, Mark S.; [2007]; 17 pp.; In English; 8th Gossamer Spacecraft Forum, 23-26 Apr. 2007, Honolulu, HI, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAG8-1912; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032064

Neural network-based adaptive control is considered for active control of a highly flexible truss structure which may be used to support solar sail membranes. The objective is to suppress unwanted vibrations in SAFE (Solar Array Flight Experiment) boom, a test-bed located at NASA. Compared to previous tests that restrained truss structures in planar motion, full three dimensional motions are tested. Experimental results illustrate the potential of adaptive control in compensating for nonlinear actuation and modeling error, and in rejecting external disturbances.
Author
Adaptive Control; Trusses; Solar Arrays; Spacecraft Configurations; Control Systems Design; Neural Nets

20070032065 NASA Marshall Space Flight Center, Huntsville, AL, USA
TRL Assessment of Solar Sail Technology Development Following the 20-Meter System Ground Demonstrator Hardware Testing
Young, Roy M.; Montgomery, Edward E.; Montgomery, Sandy; Adams, Charles L.; [2007]; 11 pp.; In English; 8th Gossamer Spacecraft Forum, 23-26 Apr. 2007, Honolulu, HI, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032065

The NASA In-Space Propulsion Technology (ISPT) Projects Office has been sponsoring 2 separate, independent system design and development hardware demonstration activities during 2002-2005. ATK Space Systems of Goleta, CA was the prime contractor for one development team and L'Garde, Inc. of Tustin, CA was the prime contractor for the other development team. The goal of these activities was to advance the technology readiness level (TRL) of solar sail propulsion from 3 towards 6 by the year 2006. Component and subsystem fabrication and testing were completed successfully, including the ground deployment of 10-meter and 20-meter ground demonstration hardware systems under vacuum conditions. The deployment and structural testing of the 20-meter solar sail systems was conducted in the 30 meter diameter Space Power Facility thermal-vacuum chamber at NASA Glenn Plum Brook in April though August, 2005. This paper will present the results of the TRL assessment following the solar sail technology development activities associated with the design, development, analysis and testing of the 20-meter system ground demonstrators. Descriptions of the system designs for both the ATK and L'Garde systems will be presented. Changes, additions and evolution of the system designs will be highlighted. A description of the modeling and analyses activities performed by both teams, as well as testing conducted to raise the TRL of solar sail technology will be presented. A summary of the results of model correlation activities will be presented. Finally, technology gaps identified during the assessment and gap closure plans will be presented, along with 'lessons learned', subsequent planning activities and validation flight opportunities for solar sail propulsion technology.
Author
Ground Tests; Solar Sails; Hardware; Technology Utilization; Systems Engineering; Aerospace Systems

20070032066 NASA Marshall Space Flight Center, Huntsville, AL, USA
Recent Developments in Smart Adaptive Structures for Solar Sailcraft
Worton, M. S.; Kim, Y. K.; Oakley, J.; Adetona, O.; Keel, L. H.; April 26, 2007; 12 pp.; In English; 8th Gossamer Spacecraft Forum, 23-26 Apr. 2007, Honolulu, HI, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032066

The 'Smart Adaptive Structures for Solar Sailcraft' development activity at MSFC has investigated issues associated with understanding how to model and scale the subsystem and multi-body system dynamics of a gossamer solar sailcraft with the objective of designing sailcraft attitude control systems. This research and development activity addressed three key tasks that leveraged existing facilities and core competencies of MSFC to investigate dynamics and control issues of solar sails. Key aspects of this effort included modeling and testing of a 30 m deployable boom; modeling of the multi-body system dynamics of a gossamer sailcraft; investigation of control-structures interaction for gossamer sailcraft; and development and experimental demonstration of adaptive control technologies to mitigate control-structures interaction.
Author
Solar Sails; Adaptive Control; Mathematical Models; Smart Structures; Control Systems Design

20070032096 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Integration and Testing Challenges of Small, Multiple Satellite Missions: Experiences from the Space Technology 5 Project

Sauerwein, Timothy A.; Gostomski, Thomas; [2007]; 7 pp.; In English; No Copyright; Avail.: CASI: A02, Hardcopy ONLINE: http://hdl.handle.net/2060/20070032096

The ST5 payload, part of NASA s New Millennium Program headquartered at JPL, consisted of three micro satellites (approx. 30 kg each) deployed into orbit from the Pegasus XL launch. ST5 was a technology demonstration mission, intended to test new technologies for potential use for future missions. In order to meet the launch date schedule of ST 5, a different approach was required rather than the standard I&T approach used for single, room-sized satellites. The I&T phase was planned for spacecraft #1 to undergo integration and test first, followed by spacecraft #2 and #3 in tandem. A team of engineers and technicians planned and executed the integration of all three spacecraft emphasizing versatility and commonality. They increased their knowledge and efficiency through spacecraft #1 integration and testing and utilized their experience and knowledge to safely execute I&T for spacecraft #2 and #3. Each integration team member could perform many different roles and functions and thus better support activities on any of the three spacecraft. The I&T campaign was completed with STS s successful launch on March 22,2006

Author

Space Transportation System; Aerospace Engineering; Payloads; Deployment; Satellites

20070032634 American Inst. of Aeronautics and Astronautics, Reston, VA, USA

ATV: Unmanned, But Everyone's on Board

Klesius, Michael; Aerospace America; June 2007; ISSN 0740-722X; Volume 45, No. 6, pp. 38-42; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

In an international effort of unprecedented complexity, ESA's Jules Verne Automated Transfer Vehicle will soon take off on its maiden voyage, which will be both a rest flight and an operational mission. The project will feature Europe's first automated docking and rendezvous in orbit as the vehicle arrives to resupply the international Space Station. For NASA, the ATV will help to bridge the gap between the shuttle's retirement and the operational start of the Orion crew exploration vehicle.

Author

Automated Transfer Vehicle; Pilotless Aircraft; Space Missions; International Space Station; Flight Tests

20070032635 NASA Goddard Space Flight Center, Greenbelt, MD, USA; Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA; Smithsonian Astrophysical Observatory, Cambridge, MA, USA; NASA Ames Research Center, Moffett Field, CA, USA

Submillimeter Wave Astronomy Satellite Conceptual Design Review

June 08, 1990; 37 pp.; In English; Submillimeter Wave Astronomy Satellite Conceptual Design Review, 8 Jun. 1990, Greenbelt, MD, USA; Original contains black and white illustrations

Report No.(s): SWAS-107; Copyright; Avail.: CASI: A03, Hardcopy

The SWAS instrument consists of the moving telescope assembly, the interface baseplate assembly, and the thermal control housing. The moving telescope structure holds the primary mirror, secondary mirror, and receiver front end in precise alignment. This structure also carries the receiver cold plate radiators, which view cold space both directly and through reflection off the primary mirror. The moving telescope assembly attaches to the interface baseplate with an open pivot frame through which flex leads from the receiver front end also pass. Two flexure-mounted linear actuators tilt the moving telescope assembly up to +/-3 deg in two axes. The interface plate serves as a mounting for these actuators as well as the acousto-optic spectrometer, the instrument control electronics, the star tracker, and the balance of the receiver components. The thermal control housing attaches to the interface baseplate around its edge. The top cylindrical part of this housing serves to shade the receiver cold plate radiators from Sun and Earth influence. The bottom 'D' shaped portion of the housing is thermally isolated from the top and forms the electronlcs radiator. Heat is conducted from the Interface baseplate into this lower portion of the shell. The radiator geometry and conduction paths create a very stable thermal environment in the center of the interface baseplate where the AOS and receiver IF amplifiers are heat sinked. The outer surface of the thermal control housing is covered with fused silica second surface mirrors that reflect visible light and radiate infrared energy. The instrument is mounted to the spacecraft through four thermally-isolating titanium flexures an the underside of the interface baseplate.

Derived from text

Design Analysis; Submillimeter Wave Astronomy Satellite; Satellite Design; Spacecraft Structures; Structural Design; Telescopes; Astronomical Observatories

20070032651 NASA Marshall Space Flight Center, Huntsville, AL, USA
Comparison of Focused and Near-Field Imaging of Spray on Foam Insulation (SOFI) at Millimeter Wave Frequencies
Kharkovsky, S.; Zoughi, R.; Hepburn, F. L.; [2007]; 1 pp.; In English; 3rd International Conference on Electromagnetic Near-Field Characterization and Imaging (ICONIC 2007), 27-29 Jun. 2007, Saint Louis, MO, USA
Contract(s)/Grant(s): NNM06AA06G; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032651

The Space Shuttle Columbia's catastrophic accident was due to a piece of Spray on Foam Insulation (SOFI) that broke off from the external tank and damaged the leading edge of the orbiter's left wing. Millimeter wave focused and near-field imaging methods have been suessfully used for inspecting of the SOFI samples. Comparison between these methods for the purpose of detection and evaluation of flaws in the SOFI is provided using examples of images of SOFI samples.
Derived from text
Foams; Imaging Techniques; Millimeter Waves; Near Fields; Sprayers; Columbia (Orbiter); Space Shuttles; Thermal Insulation

20070032657 AI Solutions, Inc., Lanham, MD, USA
Understanding Maneuver Uncertainties during Inclination Maneuvers of the Aqua Spacecraft
McKinley, David P.; August 19, 2007; 17 pp.; In English; AAS/AIAA Astrodynamics Specialist Conference, 19-23 Sep. 2007, Mackinac Island, MI, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNG04DA01C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032657

During the Fall 2006 inclination campaign for the Aqua spacecraft it was discovered that there was significant uncertainty in the prediction of the semimajor axis change during a maneuver. The low atmospheric drag environment at the time of the maneuvers amplified the effects of this uncertainty leading to a potential violation of the spacecraft ground-track requirements. In order to understand the uncertainty, a Monte Carlo simulation was developed to characterize the expected semi-major axis change uncertainty given the observed behavior of the spacecraft propulsion and attitude control systems during a maneuver. This expected uncertainty was then used to develop new analysis tools to ensure that future inclination maneuver plans will .meet ground-track control requirements in the presence of the error.
Author
Spacecraft Maneuvers; Attitude Control; Aqua Spacecraft; Drag; Monte Carlo Method; Spacecraft Propulsion

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SPACECRAFT INSTRUMENTATION AND ASTRIONICS

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

20070031811 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Mars Miniature Science Instruments
Kim, Soon Sam; Hayati, Samad; Lavery, David; McBrid, Karen; March 4, 2006; 12 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40192

For robotic Mars missions, all the science information is gathered through on-board miniature instruments that have been developed through many years of R&D. Compared to laboratory counterparts, the rover instruments require miniaturization, such as low mass (1-2 kg), low power (> 10 W) and compact (1-2 liter), yet with comparable sensitivity. Since early 1990's, NASA recognized the need for the miniature instruments and launched several instrument R&D programs, e.g., PIDDP (Planetary Instrument Definition and Development). However, until 1998, most of the instrument R&D programs supported only up to a breadboard level (TRL 3, 4) and there is a need to carry such instruments to flight qualifiable status (TU 5, 6) to respond to flight AOs (Announcement of Opportunity). Most of flight AOs have only limited time and financial resources, and can not afford such instrument development processes. To bridge the gap between instrument R&D programs and the flight instrument needs, NASA's Mars Technology Program (MTP) created advanced instrumentation program, Mars Instrument Development Project (MIDP). MIDP candidate instruments are selected through NASA Research Announcement (NRA)

process [l]. For example, MIDP 161998-2000) selected and developed 10 instruments, MIDP II (2003-2005) 16 instruments, and MIDP III (2004-2006) II instruments.Working with PIs, JPL has been managing the MIDP tasks since September 1998. All the instruments being developed under MIDP have been selected through a highly competitive NRA process, and employ state-of-the-art technology. So far, four MIDP funded instruments have been selected by two Mars missions (these instruments have further been discussed in this paper).
Author
Mars Missions; Miniaturization; Robotics; Flight Instruments; Breadboard Models

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SPACECRAFT PROPULSION AND POWER

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

20070031765 NASA Langley Research Center, Hampton, VA, USA
Computational Study of an Axisymmetric Dual Throat Fluidic Thrust Vectoring Nozzle for a Supersonic Aircraft Application
Deere, Karen A.; Flamm, Jeffrey D.; Berrier, Bobby L.; Johnson, Stuart K.; July 08, 2007; 23 pp.; In English; 43rd AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 July 2007, Cincinnati, OH, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2007-5085; Copyright; Avail.: CASI: A03, Hardcopy

A computational investigation of an axisymmetric Dual Throat Nozzle concept has been conducted. This fluidic thrust-vectoring nozzle was designed with a recessed cavity to enhance the throat shifting technique for improved thrust vectoring. The structured-grid, unsteady Reynolds- Averaged Navier-Stokes flow solver PAB3D was used to guide the nozzle design and analyze performance. Nozzle design variables included extent of circumferential injection, cavity divergence angle, cavity length, and cavity convergence angle. Internal nozzle performance (wind-off conditions) and thrust vector angles were computed for several configurations over a range of nozzle pressure ratios from 1.89 to 10, with the fluidic injection flow rate equal to zero and up to 4 percent of the primary flow rate. The effect of a variable expansion ratio on nozzle performance over a range of freestream Mach numbers up to 2 was investigated. Results indicated that a 60 circumferential injection was a good compromise between large thrust vector angles and efficient internal nozzle performance. A cavity divergence angle greater than 10 was detrimental to thrust vector angle. Shortening the cavity length improved internal nozzle performance with a small penalty to thrust vector angle. Contrary to expectations, a variable expansion ratio did not improve thrust efficiency at the flight conditions investigated.
Author
Design Analysis; Nozzle Design; Supersonic Aircraft; Flow Velocity; Free Flow; Reynolds Averaging; Structured Grids (Mathematics)

20070031863 ManTech International Corp., USA
Why Not Space Tethers?
Stone, Noble H.; May 14, 2007; 34 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM06AC61D; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031863

The Tethered Satellite System Space Shuttle missions, TSS-1 in 1993 and TSS-1R in 1996, were the height of space tether technology development. Since NASA's investment of some $200M and two Shuttle missions in those two pioneering missions, there have been several smaller tether flight experiments, but interest in this promising technology has waned within NASA as well as the DOD agencies. This is curious in view of the unique capabilities of space tether systems and the fact that they have been flight validated and shown to perform as, or better than, expected in earth orbit. While it is true that the TSS-1, TSS-1R and SEDS-2 missions experienced technical difficulties, the causes of these early developmental problems are now known to be design or materials flaws that are (1) unrelated to the basic viability of space tether technology, and (2) they are readily corrected. The purpose of this paper is to review the dynamic and electrodynamic fundamentals of space tethers and the unique capabilities they afford (that are enabling to certain types of space missions); to elucidate the nature, cause, and solution of the early developmental problems; and to provide an update on progress made in development of the

technology. Finally, it is shown that (1) all problems experienced during early development of the technology now have solutions; and (2) the technology has been matured by advances made in strength and robustness of tether materials, high voltage engineering in the space environment, tether health and status monitoring, and the elimination of the broken tether hazard. In view of this, it is inexplicable why this flight-validated technology has not been utilized in the past decade, considering the powerful and unique capabilities that space tethers can afford that are, not only required to carryout, otherwise, unobtainable missions, but can also greatly reduce the cost of certain on-going space operations.
Author
Space Shuttle Missions; Tethered Satellites; NASA Space Programs; Technology Utilization; Electrodynamics

20070031865 NASA Marshall Space Flight Center, Huntsville, AL, USA
Space Test of Bare-Wire Anode Tethers
Johnson, L.; Fujii, H. A.; Sanmartin, J. R.; May 14, 2007; 6 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

An international team, lead by Tokyo Metropolitan University, is developing a mission concept for a suborbital test of orbital-motion-limited (OML) bare-wire anode current collection for application to electrodynamic tether propulsion. The tether is a tape with a 50-mm width, 0.05-mm thickness, and 1-km length. This will be the first space test of the OML theory. In addition, by being an engineering demonstration (of space tethers), the mission will demonstrate electric beam generation for 'sounding' determination of the neutral density profile in the ionospheric 'E-layer.' If selected by the Institute of Space and Astronautical Science/Japanese Aerospace Exploration Agency (JAXA), the mission will launch in early 2009 using an $520 Sounding Rocket. During ascent, and above =100 km in attitude, the 1-km tape tether will be deployed at a rate of 8 m/s. Once deployed, the tape tether will serve as an anode, collecting ionospheric electrons. The electrons will be expelled into space by a hollow cathode device, thereby completing the circuit and allowing current to flow.This paper will describe the objectives of the proposed mission, the technologies to be employed, and the application of the results to future space missions using electrodynamic tethers for propulsion or power generation.
Author
Tetherlines; Electrostatic Propulsion; Spacecraft Propulsion; E Region; Anodes; Electric Wire

20070031866 NASA Marshall Space Flight Center, Huntsville, AL, USA
Application of Semi Active Control Techniques to the Damping Suppression Problem of Solar Sail Booms
Adetona, O.; Keel, L. H.; Whorton, M. S.; May 14, 2007; 13 pp.; In English; JANNAF JPM-MSS-LPS-SPS 2007 Meeting, 14-17 May 2007, Denver, CO, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM05AA13G; Copyright; Avail.: CASI: A03, Hardcopy

Solar sails provide a propellant free form for space propulsion. These are large flat surfaces that generate thrust when they are impacted by light. When attached to a space vehicle, the thrust generated can propel the space vehicle to great distances at significant speeds. For optimal performance the sail must be kept from excessive vibration. Active control techniques can provide the best performance. However, they require an external power-source that may create significant parasitic mass to the solar sail. However, solar sails require low mass for optimal performance. Secondly, active control techniques typically require a good system model to ensure stability and performance. However, the accuracy of solar sail models validated on earth for a space environment is questionable. An alternative approach is passive vibration techniques. These do not require an external power supply, and do not destabilize the system. A third alternative is referred to as semi-active control. This approach tries to get the best of both active and passive control, while avoiding their pitfalls. In semi-active control, an active control law is designed for the system, and passive control techniques are used to implement it. As a result, no external power supply is needed so the system is not destabilize-able. Though it typically underperforms active control techniques, it has been shown to out-perform passive control approaches and can be unobtrusively installed on a solar sail boom. Motivated by this, the objective of this research is to study the suitability of a Piezoelectric (PZT) patch actuator/sensor based semi-active control system for the vibration suppression problem of solar sail booms. Accordingly, we develop a suitable mathematical and computer model for such studies and demonstrate the capabilities of the proposed approach with computer simulations.
Author
Active Control; Solar Sails; Control Systems Design; Damping; Thrust; Vibration

20070031870 NASA Marshall Space Flight Center, Huntsville, AL, USA
Plasma Propulsion Testing Capabilities at Arnold Engineering Development Center
Polzin, Kurt A.; Dawbarn, Albert; Moeller, Trevor; May 14, 2007; 3 pp.; In English; 54th JPM/3rd LPS/2nd SPS/5th MSS Joint Meeting, 14-17 May 2007, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

This paper describes the results of a series of experiments aimed at quantifying the plasma propulsion testing capabilities

of a 12-ft diameter vacuum facility (12V) at USAF-Arnold Engineering Development Center (AEDC). Vacuum is maintained in the 12V facility by cryogenic panels lining the interior of the chamber. The pumping capability of these panels was shown to be great enough to support plasma thrusters operating at input electrical power >20 kW. In addition, a series of plasma diagnostics inside the chamber allowed for measurement of plasma parameters at different spatial locations, providing information regarding the chamber's effect on the global plasma thruster flowfield. The plasma source used in this experiment was Hall thruster manufactured by Busek Co. The thruster was operated at up to 20 kW steady-state power in both a lower current and higher current mode. The vacuum level in the chamber never rose above 9 x 10(exp -6) torr during the course of testing. Langmuir probes, ion flux probes, and Faraday cups were used to quantify the plasma parameters in the chamber. We present the results of these measurements and estimates of pumping speed based on the background pressure level and thruster propellant mass flow rate.
Author
Plasma Propulsion; Hall Thrusters; Vacuum Chambers; Plasma Engines; Mass Flow Rate; Flux (Rate); Flow Distribution

20070031871 NASA Marshall Space Flight Center, Huntsville, AL, USA
Development of the Functional Flow Block Diagram for the J-2X Rocket Engine System
White, Thomas; Stoller, Sandra L.; Greene, WIlliam D.; Christenson, Rick L.; Bowen, Barry C.; May 14, 2007; 1 pp.; In English; JANNAF Interagency Propulsion Conference, 14-17 May 2007, Denver, CO, USA
Contract(s)/Grant(s): NNM06AB13C; Copyright; Avail.: Other Sources; Abstract Only

The J-2X program calls for the upgrade of the Apollo-era Rocketdyne J-2 engine to higher power levels, using new materials and manufacturing techniques, and with more restrictive safety and reliability requirements than prior human-rated engines in NASA history. Such requirements demand a comprehensive systems engineering effort to ensure success. Pratt & Whitney Rocketdyne system engineers performed a functional analysis of the engine to establish the functional architecture. J-2X functions were captured in six major operational blocks. Each block was divided into sub-blocks or states. In each sub-block, functions necessary to perform each state were determined. A functional engine schematic consistent with the fidelity of the system model was defined for this analysis. The blocks, sub-blocks, and functions were sequentially numbered to differentiate the states in which the function were performed and to indicate the sequence of events. The Engine System was functionally partitioned, to provide separate and unique functional operators. Establishing unique functional operators as work output of the System Architecture process is novel in Liquid Propulsion Engine design. Each functional operator was described such that its unique functionality was identified. The decomposed functions were then allocated to the functional operators both of which were the inputs to the subsystem or component performance specifications. PWR also used a novel approach to identify and map the engine functional requirements to customer-specified functions. The final result was a comprehensive Functional Flow Block Diagram (FFBD) for the J-2X Engine System, decomposed to the component level and mapped to all functional requirements. This FFBD greatly facilitates component specification development, providing a well-defined trade space for functional trades at the subsystem and component level. It also provides a framework for function-based failure modes and effects analysis (FMEA), and a rigorous baseline for the functional architecture.
Author
J-2 Engine; Functional Analysis; Block Diagrams; Failure Analysis; Component Reliability; Engine Parts; Systems Engineering; Rocket Engines

20070031879 NASA Marshall Space Flight Center, Huntsville, AL, USA
Recent Advances in Nuclear Powered Electric Propulsion for Space Exploration
Cassady, R. Joseph; Frisbee, Robert H.; Gilland, James H.; Houts, Michael G.; LaPointe, Michael R.; Maresse-Reading, Colleen M.; Oleson, Steven R.; Polk, James E.; Russell, Derrek; Sengupta, Anita; [2007]; 81 pp.; In English; Copyright; Avail.: CASI: A05, Hardcopy

Nuclear and radioisotope powered electric thrusters are being developed as primary in-space propulsion systems for potential future robotic and piloted space missions. Possible applications for high power nuclear electric propulsion include orbit raising and maneuvering of large space platforms, lunar and Mars cargo transport, asteroid rendezvous and sample return, and robotic and piloted planetary missions, while lower power radioisotope electric propulsion could significantly enhance or enable some future robotic deep space science missions. This paper provides an overview of recent U.S. high power electric thruster research programs, describing the operating principles, challenges, and status of each technology. Mission analysis is presented that compares the benefits and performance of each thruster type for high priority NASA missions. The status of

space nuclear power systems for high power electric propulsion is presented. The paper concludes with a discussion of power and thruster development strategies for future radioisotope electric propulsion systems,
Author
Nuclear Electric Propulsion; Electric Propulsion; Propulsion System Configurations; Deep Space; NASA Programs; Propulsion System Performance; Robotics

20070031880 NASA Marshall Space Flight Center, Huntsville, AL, USA
Research Opportunities in Space Propulsion
Rodgers, Stephen L.; [2007]; 6 pp.; In English; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031880

Rocket propulsion determines the primary characteristics of any space vehicle; how fast and far it can go, its lifetime, and its capabilities. It is the primary factor in safety and reliability and the biggest cost driver. The extremes of heat and pressure produced by propulsion systems push the limits of materials used for manufacturing. Space travel is very unforgiving with little room for errors, and so many things can go wrong with these very complex systems. So we have to plan for failure and that makes it costly. But what is more exciting than the roar of a rocket blasting into space? By its nature the propulsion world is conservative. The stakes are so high at every launch, in terms of payload value or in human life, that to introduce new components to a working, qualified system is extremely difficult and costly. Every launch counts and no risks are tolerated, which leads to the space world's version of Catch-22:'You can't fly till you flown.' The last big 'game changer' in propulsion was the use of liquid hydrogen as a fuel. No new breakthrough, low cost access to space system will be developed without new efficient propulsion systems. Because there is no large commercial market driving investment in propulsion, what propulsion research is done is sponsored by government funding agencies. A further difficulty in propulsion technology development is that there are so few new systems flying. There is little opportunity to evolve propulsion technologies and to update existing systems with results coming out of research as there is in, for example, the auto industry. The biggest hurdle to space exploration is getting off the ground. The launch phase will consume most of the energy required for any foreseeable space exploration mission. The fundamental physical energy requirements of escaping earth's gravity make it difficult. It takes 60,000 kJ to put a kilogram into an escape orbit. The vast majority (-97%) of the energy produced by a launch vehicle is used to get propellants off the ground to be burned later. A modem launch vehicle is usually able to put no more than 1.5%-3% of its total liftoff weight into low earth orbit.
Author
Propulsion System Configurations; Propulsion System Performance; Complex Systems; Liquid Hydrogen; Launching

20070031885 NASA Marshall Space Flight Center, Huntsville, AL, USA
Throttling Impacts on Hall Thruster Performance, Erosion, and Qualification for NASA Science Missions
Dankanich, John W.; DeHoyos, Amado; [2007]; 11 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

With the SMART-1, Department of Defense, and commercial industry successes in Hall thruster technologies, NASA has started considering Hall thrusters for science missions. The recent Discovery proposals included a Hall thruster science mission and the In-Space Propulsion Project is investing in Hall thruster technologies. As the confidence in Hall thrusters improve, ambitious multi-thruster missions are being considered. Science missions often require large throttling ranges due to the 1/r(sup 2) power drop-off from the sun. Deep throttling of Hall thrusters will impact the overall system performance. Also, Hall thrusters can be throttled with both current and voltage, impacting erosion rates and performance. Last, electric propulsion thruster lifetime qualification has previously been conducted with long duration full power tests. Full power tests may not be appropriate for NASA science missions, and a combination of lifetime testing at various power levels with sufficient analysis is recommended. Analyses of various science missions and throttling schemes using the Aerojet BPT-4000 and NASA 103M HiVHAC thruster are presented.
Author
Hall Thrusters; Electric Propulsion; Throttling; Space Missions

20070031888 NASA Marshall Space Flight Center, Huntsville, AL, USA
Status of Magnetohydrodynamic Augmented Propulsion Experiment
Litchford, Ron J.; Lineberry, John T.; June 28, 2007; 14 pp.; In English; 38th AlAA Plasmadynamlcs and Lasers Conference, 25-28 Jun. 2007, Miami, FL, USA
Contract(s)/Grant(s): SAA8-05786; SAA8-05952
Report No.(s): AIAA Paper 2007-3884; Copyright; Avail.: CASI: A03, Hardcopy

Over the past several years, efforts have been under way to design and develop an operationally flexible research facility

for investigating the use of cross-field MHD accelerators as a potential thrust augmentation device for thermal propulsion systems, The baseline configuration for this high-power experimental facility utilizes a 1,5-MW, multi-gas arc-heater as a thermal driver for a 2-MW, MHD accelerator, which resides in a large-bore 2-tesla electromagnet. A preliminary design study using NaK seeded nitrogen as the working fluid led to an externally diagonalized segmented MHD channel configuration based on an expendable beat-sink design concept. The current status report includes a review of engineering/design work and performance optimization analyses and summarizes component hardware fabrication and development efforts, preliminary testing results, and recent progress toward full-up assembly and testing

Author

Propulsion System Configurations; Magnetohydrodynamics; Thrust Augmentation; Propulsion System Performance; Crossed Fields; Design Optimization; Arc Heating

20070031893 NASA Marshall Space Flight Center, Huntsville, AL, USA

High Temperature Materials for Chemical Propulsion Applications

Elam, Sandra; Hickman, Robert; O'Dell, Scott; May 14, 2007; 1 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Radiation or passively cooled thrust chambers are used for a variety of chemical propulsion functions including apogee insertion, reaction control for launch vehicles, and primary propulsion for planetary spacecraft. The performance of these thrust chambers is limited by the operating temperature of available materials. Improved oxidation resistance and increased operating temperatures can be achieved with the use of thermal barrier coatings such as zirconium oxide (ZrO2) and hafnium oxide (HfO2). However, previous attempts to include these materials showed cracking and spalling of the oxide layer due to poor bonding. Current research at NASA's Marshall Space Flight Center (MSFC) has generated unique, high temperature material options for in-space thruster designs that are capable of up to 2500 C operating temperatures. The research is focused on fabrication technologies to form low cost Iridium,qF_.henium (Ir/Re) components with a ceramic hot wall created as an integral, functionally graded material (FGM). The goal of this effort is to further de?celop proven technologies for embedding a protective ceramic coating within the Ir/Re liner to form a robust functional gradient material. Current work includes the fabrication and testing of subscale samples to evaluate tensile, creep, thermal cyclic/oxidation, and thermophysical material properties. Larger test articles have also being fabricated and hot-fire tested to demonstrate the materials in prototype thrusters at 1O0 lbf thrust levels.

Author

Chemical Propulsion; Thermophysical Properties; Zirconium Oxides; Hafnium Oxides; Ceramic Coatings; Operating Temperature; Thrust Chambers; Protective Coatings

20070031896 NASA Marshall Space Flight Center, Huntsville, AL, USA

Lunar Surface Access Module Pump-Fed Engine Turbopump Technology

Thornton, Randall J.; May 14, 2007; 1 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA

Contract(s)/Grant(s): 698671.01.08.06.14; No Copyright; Avail.: Other Sources; Abstract Only

The need for a high specific impulse LOX/LH2 pump-fed lunar lander engine has been established by NASA for the new Exploration architecture. Preliminary studies indicate that a 4 engine cluster in the thrust range of 9,000-lbf each is a likely configuration for the main propulsion of the manned lunar lander vehicle. The main Lunar Surface Access Module engines will likely be responsible for mid-course correction burns, lunar orbit insertion burns, a deorbit burn, and the powered descent to the lunar surface. This multi-task engine philosophy imposes a wide throttling requirement on the engines in the range of 10:1. Marshall Space Flight Center has initiated an internal effort to mature the technologies needed for full scale development of such a LOX/LH2 pump-fed engine. In particular, a fuel turbopump is being designed and fabricated at MSFC to address the issues that a small high speed turbopump of this class will face. These issues include adequate throttling performance of the pump and turbine over a very wide operating range. The small scale of the hardware presents issues including performance scaling, and manufacturing issues like that will challenge the traditional methods we have used to fabricate and assemble larger scale turbopumps. The small high speed turbopump being developed at MSFC will operate at speeds greater than 100,000-rpm. These speeds create issues that include structural dynamics and high cycle fatigue as well as rotordynamic stability. The fuel turbopump development at MSFC will address these issues, and plans are in work for component level testing as well as operation in a test bed engine environment. The fuel turbopump design is nearing completion and described herein.

Author

Liquid Hydrogen; Hydrogen Oxygen Engines; Specific Impulse; Turbine Pumps; Dynamic Response; Rotor Dynamics

20070031897 NASA Marshall Space Flight Center, Huntsville, AL, USA

Demonstration of a Non-Toxic Reaction Control Engine

Robinson, Philip J.; Turpin, Alicia A.; Veith, Eric M.; May 14, 2007; 1 pp.; In English; 54th JPM/3rd LPS/2nd SPS/5th MSS Joint JANNAF Meeting, 14-17 May 2007, Denver, CO, USA

Contract(s)/Grant(s): NAS8-01109; No Copyright; Avail.: Other Sources; Abstract Only

T:hree non-toxic demonstration reaction control engines (RCE) were successfully tested at the Aerojet Sacramento facility under a technology contract sponsored by the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center (MSFC). The goals of the NASA MSFC contract (NAS8-01109) were to develop and expand the technical maturity of a non-toxic, on-orbit auxiliary propulsion system (APS) thruster under the auspices of the Exploration Systems Mission Directorate. The demonstration engine utilized Liquid Oxygen (LOX) and Ethanol as propellants to produce 870 lbf thrust. The Aerojet RCE's were successfully acceptance tested over a broad range of operating conditions. Steady state tests evaluated engine response to varying chamber pressures and mixture ratios. In addition to the steady state tests, a variety of pulsing tests were conducted over a wide range of electrical pulse widths (EPW). Each EPW condition was also tested over a range of percent duty cycles (DC), and bit impulse and pulsing specific impulse were determined for each of these conditions. Subsequent to acceptance testing at Aerojet, these three engines were delivered to the NASA White Sands Test Facility (WSTF) in April 2005 for incorporation into a cryogenic Auxiliary Propulsion System Test Bed (APSTB). The APSTB is a test article that will be utilized in an altitude test cell to simulate anticipated mission applications. The objectives of this APSTB testing included evaluation of engine performance over an extended duty cycle map of propellant pressure and temperature, as well as engine and system performance at typical mission duty cycles over extended periods of time. This paper provides acceptance test results and a status of the engine performance as part of the system level testing.

Author

Cryogenic Rocket Propellants; Auxiliary Propulsion; Specific Impulse; Liquid Oxygen; Ethyl Alcohol; Altitude Tests

20070031912 NASA Glenn Research Center, Cleveland, OH, USA

Energy Considerations of Hypothetical Space Drives

Millis, Marc G.; July 09, 2007; 10 pp.; In English; 43rd Joint Propulsion Conference, 9-12 Jul. 2007, Cincinnati, OH, USA; Original contains black and white illustrations

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ONLINE: http://hdl.handle.net/2060/20070031912

The energy requirements of hypothetical, propellant-less space drives are compared to rockets. This serves to provide introductory estimates for potential benefits and to suggest analytical approaches for further study. A 'space drive' is defined as an idealized form of propulsion that converts stored potential energy directly into kinetic energy using only the interactions between the spacecraft and its surrounding space. For Earth-to-orbit, the space drive uses 3.7 times less energy. For deep space travel, energy is proportional to the square of delta-v, whereas rocket energy scales exponentially. This has the effect of rendering a space drive 150-orders-of-magnitude better than a 17,000-s Specific Impulse rocket for sending a modest 5000 kg probe to traverse 5 ly in 50 years. Indefinite levitation, which is impossible for a rocket, could conceivably require 62 MJ/kg for a space drive. Assumption sensitivities and further analysis options are offered to guide further inquires.

Author

Spacecraft Propulsion; Energy Requirements; Potential Energy; Kinetic Energy; Deep Space

20070031914 NASA Marshall Space Flight Center, Huntsville, AL, USA

Adaptive Control of Truss Structures for Gossamer Spacecraft

Yang, Bong-Jun; Calise, Anthony J.; Craig, James I.; Whorton, Mark S.; May 14, 2007; 19 pp.; In English; JANNAF JPM-MSS-LPS-SPS 2007 Conference, 14-17 May 2007, Denver, CO, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NAG8-1912; Copyright; Avail.: CASI: A03, Hardcopy

Neural network-based adaptive control is considered for active control of a highly flexible truss structure which may be used to support solar sail membranes. The objective is to suppress unwanted vibrations in SAFE (Solar Array Flight Experiment) boom, a test-bed located at NASA. Compared to previous tests that restrained truss structures in planar motion, full three dimensional motions are tested. Experimental results illustrate the potential of adaptive control in compensating for nonlinear actuation and modeling error, and in rejecting external disturbances.

Author

Adaptive Control; Neural Nets; Trusses; Solar Sails; Test Stands; Three Dimensional Motion; Flexible Bodies

20070031915 NASA Marshall Space Flight Center, Huntsville, AL, USA

Compact and Integrated Liquid Bismuth Propellant Feed System

Polzin, Kurt A.; Stanojev, Boris; Korman, Valentin; Gross, Jeffrey T.; May 14, 2007; 2 pp.; In English; Joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Meeting, 14-17 May 2007, Denver, CO, USA

Contract(s)/Grant(s): SAA8-061060; Copyright; Avail.: Other Sources; Abstract Only

Operation of Hall thrusters with bismuth propellant has been shown to be a promising path toward high-power, high-performance, long-lifetime electric propulsion for spaceflight missions [1]. There has been considerable effort in the past three years aimed at resuscitating this promising technology and validating earlier experimental results indicating the advantages of a bismuth-fed Hall thruster. A critical element of the present effort is the precise metering of propellant to the thruster, since performance cannot be accurately assessed without an accurate accounting of mass flow rate. Earlier work used a pre./post-test propellant weighing scheme that did not provide any real-time measurement of mass flow rate while the thruster was firing, and makes subsequent performance calculations difficult. The motivation of the present work is to develop a precision liquid bismuth Propellant Management System (PMS) that provides hot, molten bismuth to the thruster while simultaneously monitoring in real-time the propellant mass flow rate. The system is a derivative of our previous propellant feed system [2], but the present system represents a more compact design. In addition, all control electronics are integrated into a single unit and designed to reside on a thrust stand and operate in the relevant vacuum environment where the thruster is operating, significantly increasing the present technology readiness level of liquid metal propellant feed systems. The design of various critical components in a bismuth PMS are described. These include the bismuth reservoir and pressurization system, 'hotspot' flow sensor, power system and integrated control system. Particular emphasis is given to selection of the electronics employed in this system and the methods that were used to isolate the power and control systems from the high-temperature portions of the feed system and thruster. Open loop calibration test results from the 'hotspot' flow sensor are reported, and results of integrated thruster/PMS tests demonstrate operation of the feed system in the relevant environment.
Author

Liquid Rocket Propellants; Hall Thrusters; Electric Propulsion; Real Time Operation; Systems Integration; High Temperature; Mass Flow Rate; Feed Systems; Bismuth

20070031964 NASA Marshall Space Flight Center, Huntsville, AL, USA

Nuclear Thermal Propulsion Mars Mission Systems Analysis and Requirements Definition

Mulqueen, Jack; Chiroux, Robert C.; Thomas, Dan; Crane, Tracie; June 24, 2007; 11 pp.; In English; 2007 Space Nuclear Conference; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

This paper describes the Mars transportation vehicle design concepts developed by the Marshall Space Flight Center (MSFC) Advanced Concepts Office. These vehicle design concepts provide an indication of the most demanding and least demanding potential requirements for nuclear thermal propulsion systems for human Mars exploration missions from years 2025 to 2035. Vehicle concept options vary from large 'all-up' vehicle configurations that would transport all of the elements for a Mars mission on one vehicle. to 'split' mission vehicle configurations that would consist of separate smaller vehicles that would transport cargo elements and human crew elements to Mars separately. Parametric trades and sensitivity studies show NTP stage and engine design options that provide the best balanced set of metrics based on safety, reliability, performance, cost and mission objectives. Trade studies include the sensitivity of vehicle performance to nuclear engine characteristics such as thrust, specific impulse and nuclear reactor type. Tbe associated system requirements are aligned with the NASA Exploration Systems Mission Directorate (ESMD) Reference Mars mission as described in the Explorations Systems Architecture Study (ESAS) report. The focused trade studies include a detailed analysis of nuclear engine radiation shield requirements for human missions and analysis of nuclear thermal engine design options for the ESAS reference mission.
Author

Nuclear Propulsion; Mars Missions; Mission Planning; Design Analysis; Specific Impulse; Systems Analysis; Propulsion System Configurations; Engine Design

20070031967 NASA Marshall Space Flight Center, Huntsville, AL, USA

Development of an Efficient CFD Model for Nuclear Thermal Thrust Chamber Assembly Design

Cheng, Gary; Ito, Yasushi; Ross, Doug; Chen, Yen-Sen; Wang, Ten-See; June 25, 2007; 11 pp.; In English; 39th AIAA Thermophysics Conference, 27-28 Jun. 2007, Miami, FL, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The objective of this effort is to develop an efficient and accurate computational methodology to predict both detailed

thermo-fluid environments and global characteristics of the internal ballistics for a hypothetical solid-core nuclear thermal thrust chamber assembly (NTTCA). Several numerical and multi-physics thermo-fluid models, such as real fluid, chemically reacting, turbulence, conjugate heat transfer, porosity, and power generation, were incorporated into an unstructured-grid, pressure-based computational fluid dynamics solver as the underlying computational methodology. The numerical simulations of detailed thermo-fluid environment of a single flow element provide a mechanism to estimate the thermal stress and possible occurrence of the mid-section corrosion of the solid core. In addition, the numerical results of the detailed simulation were employed to fine tune the porosity model mimic the pressure drop and thermal load of the coolant flow through a single flow element. The use of the tuned porosity model enables an efficient simulation of the entire NTTCA system, and evaluating its performance during the design cycle.
Author
Computational Fluid Dynamics; Thrust Chambers; Heat Transfer; Turbulence; Unstructured Grids (Mathematics)

20070031971 NASA Marshall Space Flight Center, Huntsville, AL, USA
Capabilities and Testing of the Fission Surface Power Primary Test Circuit (FSP-PTC)
Garber, Anne E.; June 25, 2007; 10 pp.; In English; Space Nuclear Conference 2007, 25-28 Jun. 2007, Boston, MA, USA; Original contains color and black and white illustrations
Report No.(s): Paper 2030; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031971

An actively pumped alkali metal flow circuit, designed and fabricated at the NASA Marshall Space Flight Center, is currently undergoing testing in the Early Flight Fission Test Facility (EFF-TF). Sodium potassium (NaK), which was used in the SNAP-10A fission reactor, was selected as the primary coolant. Basic circuit components include: simulated reactor core, NaK to gas heat exchanger, electromagnetic (EM) liquid metal pump, liquid metal flowmeter, load/drain reservoir, expansion reservoir, test section, and instrumentation. Operation of the circuit is based around a 37-pin partial-array core (pin and flow path dimensions are the same as those in a full core), designed to operate at 33 kWt. NaK flow rates of greater than 1 kg/sec may be achieved, depending upon the power applied to the EM pump. The heat exchanger provides for the removal of thermal energy from the circuit, simulating the presence of an energy conversion system. The presence of the test section increases the versatility of the circuit. A second liquid metal pump, an energy conversion system, and highly instrumented thermal simulators are all being considered for inclusion within the test section. This paper summarizes the capabilities and ongoing testing of the Fission Surface Power Primary Test Circuit (FSP-PTC).
Author
Fission; Circuits; Heat Exchangers; Flow Velocity; Test Chambers; Gas Exchange; Thermal Energy; Potassium; Sodium; Energy Conversion; Flight Tests

20070031974 NASA Langley Research Center, Hampton, VA, USA
Aerocapture Technology Developments from NASA's In-Space Propulsion Technology Program
Munk, Michelle M.; Moon, Steven A.; June 11, 2007; 6 pp.; In English; National Science and Technology Conference, 19-21 Jun. 2007, College Park, MD, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

This paper will explain the investment strategy, the role of detailed systems analysis, and the hardware and modeling developments that have resulted from the past 5 years of work under NASA's In-Space Propulsion Program (ISPT) Aerocapture investment area. The organizations that have been funded by ISPT over that time period received awards from a 2002 NASA Research Announcement. They are: Lockheed Martin Space Systems, Applied Research Associates, Inc., Ball Aerospace, NASA's Ames Research Center, and NASA's Langley Research Center. Their accomplishments include improved understanding of entry aerothermal environments, particularly at Titan, demonstration of aerocapture guidance algorithm robustness at multiple bodies, manufacture and test of a 2-meter Carbon-Carbon 'hot structure,' development and test of evolutionary, high-temperature structural systems with efficient ablative materials, and development of aerothermal sensors that will fly on the Mars Science Laboratory in 2009. Due in large part to this sustained ISPT support for Aerocapture, the technology is ready to be validated in flight.
Author
Aerocapture; Aerothermodynamics; Propulsion; Support Systems; Aerospace Systems; Systems Analysis

20070031975 NASA Marshall Space Flight Center, Huntsville, AL, USA

Performance Optimization of Storable Bipropellant Engines to Fully Exploit Advanced Material Technologies

Miller, Scott; Henderson, Scott; Portz, Ron; Lu, Frank; Wilson, Kim; Krismer, David; Alexander, Leslie; Chapman, Jack; England, Chris; June 19, 2007; 11 pp.; In English; NASA Science and Technology Conference (NSTC), 19-21 Jun, 2007, College Park, MD, USA; Original contains black and white illustrations

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ONLINE: http://hdl.handle.net/2060/20070031975

This paper summarizes the work performed to dale on the NASA Cycle 3A Advanced Chemical Propulsion Technology Program. The primary goals of the program are to design, fabricate, and test high performance bipropellant engines using iridium/rhenium chamber technology to obtain 335 seconds specific impulse with nitrogen tetroxide/hydrazine propellants and 330 seconds specific impulse with nitrogen tetroxide/monomethylhydrazine propellants. Aerojet has successfully completed the Base Period of this program, wherein (1) mission and system studies have been performed to verify system performance benefits and to determine engine physical and operating parameters, (2) preliminary chamber and nozzle designs have been completed and a chamber supplier has been downselected, (3) high temperature, high pressure off-nominal hot fire testing of an existing state-of-the-art high performance bipropellant engine has been completed, and (4) thermal and performance data from the engine test have been correlated with new thermal models to enable design of the new engine injector and injector/chamber interface. In the next phase of the program, Aerojet will complete design, fabrication, and test of the nitrogen tetroxide/hydrazine engine to demonstrate 335 seconds specific impulse, and also investigate improved technologies for iridium/rhenium chamber fabrication. Achievement of the NRA goals will significantly benefit NASA interplanetary missions and other government and commercial opportunities by enabling reduced launch weight and/or increased payload. At the conclusion of the program, the objective is to have an engine ready for final design and qualification for a specific science mission or commercial application. The program also constitutes a stepping stone to future, development, such as higher pressure pump-fed in-space storable engines.

Author

Chemical Propulsion; Engine Tests; Hydrazine Engines; Temperature Distribution; Nitrogen Tetroxide; Monomethylhydrazines; Liquid Rocket Propellants; High Temperature

20070032005 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

The Minimum Impulse Thruster

Parker, J. Morgan; Wilson, Michael J.; December 5, 2005; 17 pp.; In English; 53rd JANNAF Propulsion Meeting, 5-8 Dec. 2005, Monterey, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40187

The Minimum Impulse Thruster (MIT) was developed to improve the state-of-the-art minimum impulse capability of hydrazine monopropellant thrusters. Specifically, a new fast response solenoid valve was developed, capable of responding to a much shorter electrical pulse width, thereby reducing the propellant flow time and the minimum impulse bit. The new valve was combined with the Aerojet MR-103, 0.2 lbf (0.9 N) thruster and put through an extensive Delta-qualification test program, resulting in a factor of 5 reduction in the minimum impulse bit, from roughly 1.1 milli-lbf-seconds (5 milliNewton seconds) to - 0.22 milli-lbf-seconds (1 mN-s). To maintain it's extensive heritage, the thruster itself was left unchanged. The Minimum Impulse Thruster provides mission and spacecraft designers new design options for precision pointing and precision translation of spacecraft.

Author

Monopropellants; Hydrazines; Spacecraft Design; Pulse Duration; Pulsed Inductive Thrusters; Design Analysis

20070032049 Ohio Aerospace Inst., Brook Park, OH, USA

Helicon Wave Physics Impacts on Electrodeless Thruster Design

Gilland, James; March 17, 2003; 10 pp.; In English; International Electric Propulsion Conference ERPS, 17-21 Mar. 2003, Toulouse, France; Original contains color illustrations

Contract(s)/Grant(s): NCC3-860; WBS 22-755-70-07

Report No.(s): IEPC-0150; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032049

Effective generation of helicon waves for high density plasma sources is determined by the dispersion relation and plasma power balance. Helicon wave plasma sources inherently require an applied magnetic field of .01-0.1 T, an antenna properly

designed to couple to the helicon wave in the plasma, and an rf power source in the 10-100 s of MHz, depending on propellant choice. For a plasma thruster, particularly one with a high specific impulse (>2000 s), the physics of the discharge would also have to address the use of electron cyclotron resonance (ECR) heating and magnetic expansion. In all cases the system design includes an optimized magnetic field coil, plasma source chamber, and antenna. A preliminary analysis of such a system, calling on experimental data where applicable and calculations where required, has been initiated at Glenn Research Center. Analysis results showing the mass scaling of various components as well as thruster performance projections and their impact on thruster size are discussed.
Author
Plasma Power Sources; High Impulse; Wave Dispersion; Magnetic Fields; Specific Impulse; Plasmas (Physics); Electron Cyclotron Resonance

20070032050 NASA Glenn Research Center, Cleveland, OH, USA
MPD Thruster Performance Analytic Models
Gilland, James; Johnston, Geoffrey; February 02, 2003; 10 pp.; In English; STAIF, 2-5 Feb. 2003, Albuquerque, NM, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NCC3-860; WBS 22-755-70-07; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032050

Magnetoplasmadynamic (MPD) thrusters are capable of accelerating quasi-neutral plasmas to high exhaust velocities using Megawatts (MW) of electric power. These characteristics make such devices worthy of consideration for demanding, far-term missions such as the human exploration of Mars or beyond. Assessment of MPD thrusters at the system and mission level is often difficult due to their status as ongoing experimental research topics rather than developed thrusters. However, in order to assess MPD thrusters utility in later missions, some adequate characterization of performance, or more exactly, projected performance, and system level definition are required for use in analyses. The most recent physical models of self-field MPD thrusters have been examined, assessed, and reconfigured for use by systems and mission analysts. The physical models allow for rational projections of thruster performance based on physical parameters that can be measured in the laboratory. The models and their implications for the design of future MPD thrusters are presented.
Author
Magnetoplasmadynamic Thrusters; Performance Prediction; Systems Analysis; Magnetoplasmadynamics

20070032051 Ohio Aerospace Inst., Brook Park, OH, USA
Helicon Wave Physics Impacts on Electrodeless Thruster Design
Gilland, James H.; [2007]; 10 pp.; In English; International Electric Propulsion Conference ERPS, 17-21 Mar. 2003, Toulouse, France
Contract(s)/Grant(s): NCC3-860; WBS 22-755-70-07
Report No.(s): Paper 0150; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032051

Effective generation of helicon waves for high density plasma sources is determined by the dispersion relation and plasma power balance. Helicon wave plasma sources inherently require an applied magnetic field of .01-0.1 T, an antenna properly designed to couple to the helicon wave in the plasma, and an rf power source in the 10-100 s of MHz, depending on propellant choice. For a plasma thruster, particularly one with a high specific impulse (>2000 s), the physics of the discharge would also have to address the use of electron cyclotron resonance (ECR) heating and magnetic expansion. In all cases the system design includes an optimized magnetic field coil, plasma source chamber, and antenna. A preliminary analysis of such a system, calling on experimental data where applicable and calculations where required, has been initiated at Glenn Research Center. Analysis results showing the mass scaling of various components as well as thruster performance projections and their impact on thruster size are discussed.
Author
Plasma Power Sources; Wave Dispersion; Magnetic Fields; Radio Frequencies; Electron Cyclotron Resonance; Electron Cyclotron Heating; High Impulse

20070032052 NASA Glenn Research Center, Cleveland, OH, USA

MPD Thruster Performance Analytic Models

Gilland, James; Johnston, Geoffrey; [2007]; 10 pp.; In English; STAIF Meeting, 2-3 Feb. 2003, Albuquerque, NM

Contract(s)/Grant(s): NCC3-860; WBS 22.755-70-07; Copyright; Avail.: CASI: A02, Hardcopy

Magnetoplasmadynamic (MPD) thrusters are capable of accelerating quasi-neutral plasmas to high exhaust velocities using Megawatts (MW) of electric power. These characteristics make such devices worthy of consideration for demanding, far-term missions such as the human exploration of Mars or beyond. Assessment of MPD thrusters at the system and mission level is often difficult due to their status as ongoing experimental research topics rather than developed thrusters. However, in order to assess MPD thrusters utility in later missions, some adequate characterization of performance, or more exactly, projected performance, and system level definition are required for use in analyses. The most recent physical models of self-field MPD thrusters have been examined, assessed, and reconfigured for use by systems and mission analysts. The physical models allow for rational projections of thruster performance based on physical parameters that can be measured in the laboratory. The models and their implications for the design of future MPD thrusters are presented.

Author

Magnetoplasmadynamic Thrusters; Performance Prediction; Systems Analysis; Mathematical Models; Magnetoplasmadynamics

20070032053 NASA Glenn Research Center, Cleveland, OH, USA

Status, Vision, and Challenges of an Intelligent Distributed Engine Control Architecture

Behbahani, Alireza; Culley, Dennis; Garg, Sanjay; Millar, Richard; Smith, Bert; Wood, Jim; Mahoney, Tim; Quinn, Ronald; Carpenter, Sheldon; Mailander, Bill; Battestin, Gary; Roney, Walter; Bluish, Colin; Rhoden, William; Storey, Bill; [2007]; 23 pp.; In English; SAE Aerotech Congress and Exhibit, 17-20 Sep. 2007, Los Angeles, CA, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 561581.02.08.03.17.03; Copyright; Avail.: CASI: A03, Hardcopy

A Distributed Engine Control Working Group (DECWG) consisting of the Department of Defense (DoD), the National Aeronautics and Space Administration (NASA) Glenn Research Center (GRC) and industry has been formed to examine the current and future requirements of propulsion engine systems. The scope of this study will include an assessment of the paradigm shift from centralized engine control architecture to an architecture based on distributed control utilizing open system standards. Included will be a description of the work begun in the 1990's, which continues today, followed by the identification of the remaining technical challenges which present barriers to on-engine distributed control.

Author

Engine Control; Propulsion System Configurations; Propulsion System Performance; Distributed Parameter Systems; Active Control

20070032055 NASA Glenn Research Center, Cleveland, OH, USA

NASA Hypersonic Propulsion: Overview of Progress from 1995 to 2005

Cikanek, Harry A., III; Bartolotta, Paul A.; Klem, Mark D.; Rausch, Vince L.; [2007]; 15 pp.; In English; 18th ISABE Conference, 2-7 Sep. 2007, Beijing, China; Original contains color illustrations

Contract(s)/Grant(s): WBS 305311.01.03.01; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032055

Hypersonic propulsion work supported by the USA National Aeronautics and Space Administration had a primary focus on Space Transportation during the period from 1995 to 2005. The framework for these advances was established by policy and pursued with substantial funding. Many noteworthy advances were made, highlighted by the pinnacle flights of the X-43. This paper reviews and summarizes the programs and accomplishments of this era. The accomplishments are compared to the goals and objectives to lend an overarching perspective to what was achieved. At least dating back to the early days of the Space Shuttle program, NASA has had the objective of reducing the cost of access to space and concurrently improving safety and reliability. National Space Transportation Policy in 1994 coupled with a base of prior programs such as the National Aerospace Plane and the need to look beyond the Space Shuttle program set the stage for NASA to pursue Space Transportation Advances. Programs defined to pursue the advances represented a broad approach addressing classical rocket propulsion as well as airbreathing propulsion in various combinations and forms. The resulting portfolio of activities included systems analysis and design studies, discipline research and technology, component technology development, propulsion system ground test demonstration and flight demonstration. The types of propulsion systems that were pursued by these programs included classical rocket engines, 'aerospike' rocket engines, high performance rocket engines, scram jets, rocket based combined cycles, and turbine based combined cycles. Vehicle architectures included single and two stage vehicles.

Either single types of propulsion systems or combinations of the basic propulsion types were applied to both single and two stage vehicle design concepts. Some of the propulsion system design concepts were built and tested at full scale, large scale and small scale. Many flight demonstrators were conceptually defined, fewer designed and some built and one flown to demonstrate several technical advancements including propulsion. The X-43 flights were a culmination of these efforts for airbreathing propulsion. During the course of that period, there was a balance of funding and emphasis toward rocket propulsion but still very substantial airbreathing propulsion effort. The broad objectives of these programs were to both advance and test the state of the art so as to provide a basis for options to be pursued for broad space transportation needs, most importantly focused on crew carrying capability. NASA cooperated with the Department of Defense in planning and implementation of these programs to make efficient use of objectives and capabilities where appropriate. Much of the work was conducted in industry and academia as well as Government laboratories. Many test articles and data-bases now exist as a result of this work. At the conclusion of the period, the body of work made it clear that continued research and technology development was warranted, because although not ready for a NASA system development decision, results continued to support the promise of air-breathing propulsion for access to space.
Author
Hypersonic Flight; Propulsion System Configurations; Propulsion System Performance; Space Transportation; Flight Tests; NASA Programs; Systems Analysis; Rocket Engines; Systems Engineering

20070032061 NASA Marshall Space Flight Center, Huntsville, AL, USA
Ongoing Space Nuclear Activities
Houts, Michael G.; [2007]; 4 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032061

Most ongoing US activities related to space nuclear power and propulsion are sponsored by NASA. NASA-spons0red space nuclear work is currently focused on evaluating potential fission surface power (FSP) systems and on radioisotope power systems (RPS). In addition, significant efforts related to nuclear thermal propulsion (NTP) systems have been completed and will provide a starting point for potential future NTP work.
Derived from text
Fission; Nuclear Propulsion; Radioisotope Heat Sources; Thermoelectric Power Generation; Nuclear Fission

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*.

20070031917 NASA Marshall Space Flight Center, Huntsville, AL, USA
Measurement of Creep Properties of Ultra-High-Temperature Materials by a Novel Non-Contact Technique
Hyers, Robert W.; Lee, Jonghyun; Rogers, Jan R.; Liaw, Peter K.; May 14, 2007; 1 pp.; In English; 54th Joint JANNAF Meeting, 14-17 May 2007, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

A non-contact technique for measuring the creep properties of materials has been developed and validated as part of a collaboration among the University of Massachusetts, NASA Marshall Space Flight Center Electrostatic Levitation Facility (ESL), and the University of Tennessee. This novel method has several advantages over conventional creep testing. The sample is deformed by the centripetal acceleration from the rapid rotation, and the deformed shapes are analyzed to determine the strain. Since there is no contact with grips, there is no theoretical maximum temperature and no concern about chemical compatibility. Materials may be tested at the service temperature even for extreme environments such as rocket nozzles, or above the service temperature for accelerated testing of materials for applications such as jet engines or turbopumps for liquid-fueled engines. The creep measurements have been demonstrated to 2400 C with niobium, while the test facility, the NASA MSFC ESL, has processed materials up to 3400 C. Furthermore, the ESL creep method employs a distribution of stress to determine the stress exponent from a single test, versus the many tests required by conventional methods. Determination of the stress exponent from the ESL creep tests requires very precise measurement of the surface shape of the deformed sample for comparison to deformations predicted by finite element models for different stress exponents. An error analysis shows that the stress exponent can be determined to about 1% accuracy with the current methods and apparatus. The creep properties of

single-crystal niobium at 1985 C showed excellent agreement with conventional tests performed according to ASTM Standard E-139. Tests on other metals, ceramics, and composites relevant to rocket propulsion and turbine engines are underway.
Author
Creep Properties; Accelerated Life Tests; Creep Tests; Deformation; Stress Distribution; Stress Analysis; Rocket Nozzles; Refractory Materials; Jet Engines

20070031977 NASA Marshall Space Flight Center, Huntsville, AL, USA
Ultra-High Temperature Materials Characterization for Space and Missile Applications
Rogers, Jan; Hyers, Robert; June 25, 2007; 1 pp.; In English; 2007 National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Numerous advanced space and missile technologies including propulsion systems require operations at high temperatures. Some very high-temperature materials are being developed to meet these needs, including refractory metal alloys, carbides, borides, and silicides. System design requires data for materials properties at operating temperatures. Materials property data are not available at the desired operating temperatures for many materials of interest. The objective of this work is to provide important physical property data at ultra-high temperatures. The MSFC Electrostatic Levitation (ESL) facility can provide measurements of thermophysical properties which include: creep strength, emissivity, density and thermal expansion. ESL uses electrostatic fields to position samples between electrodes during processing and characterization experiments. Samples float between the electrodes during studies and are free from any contact with a container or test apparatus. This provides a high purity environment for the study of high-temperature, reactive materials. ESL can be used to process a wide variety of materials including metals, alloys, ceramics, glasses and semiconductors. A system for the determination of total hemispherical emissivity is being developed for the MSFC ESL facility by AZ Technology Inc. The instrument has been designed to provide emissivity measurements for samples during ESL experiments over the temperature range 700-3400K. A novel non-contact technique for the determination of high-temperature creep strength has been developed. Data from selected ESL-based characterization studies will be presented. The ESL technique could advance space and missile technologies by advancing the knowledge base and the technology readiness level for ultra-high temperature materials. Applications include non-eroding nozzle materials and lightweight, high-temperature alloys for turbines and structures.
Author
High Temperature; Refractory Metal Alloys; Carbides; Borides; Silicides; Electrostatics; Levitation; Thermophysical Properties; Creep Strength; Emissivity; Thermal Expansion; Reactivity

20070032029 NASA Marshall Space Flight Center, Huntsville, AL, USA
Triboluminescent Materials for Smart Optical Damage Sensors for Space Applications
Aggarwal, Mohan D.; Penn, Benjamin G.; Miller, Jim; May 08, 2007; 1 pp.; In English; IEEE Symposium for Space Applications of Wireless and RFID, 8-9 May 2007, Houston, TX, USA; No Copyright; Avail.: Other Sources; Abstract Only

Triboluminescence is light that is produced by pressure, friction or mechanical shock. New composite materials are constantly being reengineered in an effort to make lightweight spacecrafts for various NASA missions. For these materials there is interest in monitoring the condition of the composite in real time to detect any delamination or cracking due to damage, fatigue or external forces. Methods of periodic inspection of composite structures for mechanical damage such as ultrasonic testing are rather mature. However, there is a need to develop a new technique of damage detection for composites, which could detect cracking or delamination from any desired location within a material structure in real time. This could provide a valuable tool in the confident use of composite materials for various space applications. Recently, triboluminnescent materials have been proposed as smart sensors of structural damage. To sense the damage, these materials can be epoxy bonded or coated in a polymer matrix or embedded in a composite host structure. When the damage or fracture takes place in the host structure, it will lead to the fracture of triboluminescent crystals resulting in a light emission. This will warn, in real time, that a structural damage has occurred. The triboluminescent emission of the candidate phosphor has to be sufficiently bright, so that the light signal reaching from the point of fracture to the detector through a fiber optic cable is sufficiently strong to be detected. There are a large number of triboluminescent materials, but few satisfy the above criterion. Authors have synthesized a Eu based organic material known as Europium tetrakis (dibenzoylmethide) triethylammonium .(EuD(sub 4)TEA), one of the bright triboluminescent materials, which is a potential candidate for application as a damage sensor and could be made into a wireless sensor with the addition of microchip, antenna and electronics. Preliminary results on the synthesis and characterization of this material shall be presented.
Author
Composite Materials; Damage; Detection; Fracturing; Triboluminescence; Warning Systems; Monitors

24
COMPOSITE MATERIALS

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

20070031768 NASA Langley Research Center, Hampton, VA, USA
Emissivity Results on High Temperature Coatings for Refractory Composite Materials
Ohlhorst, Craig W.; Vaughn, Wallace L.; Daryabeigi, Kamran; Lewis, Ronald K.; Rodriguez, Alvaro C.; Milhoan, James D.; Koenig, John R.; June 24, 2007; 15 pp.; In English; 29th International Thermal Conductivity Conference (ITCC) and 17th International Expansion Symposium, 24-27 Jun. 2007, Birmingham, AL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 599489.02.07.07.02.01; Copyright; Avail.: CASI: A03, Hardcopy

The directional emissivity of various refractory composite materials considered for application for reentry and hypersonic vehicles was investigated. The directional emissivity was measured at elevated temperatures of up to 3400 F using a directional spectral radiometric technique during arc-jet test runs. A laboratory-based relative total radiance method was also used to measure total normal emissivity of some of the refractory composite materials. The data from the two techniques are compared. The paper will also compare the historical database of Reinforced Carbon-Carbon emissivity measurements with emissivity values generated recently on the material using the two techniques described in the paper.
Author
Refractory Materials; Composite Materials; Emissivity; Reentry Vehicles; Hypersonic Vehicles; High Temperature; Carbon-Carbon Composites

20070031772 NASA Langley Research Center, Hampton, VA, USA
Hypervelocity Impact (HVI), Volume 7, WLE High Fidelity Specimen RCC16R
Gorman, Michael R.; Ziola, Steven M.; September 2007; 110 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06
Report No.(s): NASA/CR-2007-214885/VOL7; No Copyright; Avail.: CASI: A06, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031772

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Target RCC16R was to study hypervelocity impacts through the reinforced carbon-carbon (RCC) panels of the Wing Leading Edge. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.
Author
Hypervelocity Impact; Leading Edges; Wings; Space Shuttles; Impact Tests; Carbon-Carbon Composites

20070031803 NASA Glenn Research Center, Cleveland, OH, USA
Enhancement of Hydrophilic Characteristics of Non-Wetting Porous Substrates by Kaolinite Treatment
Khan, Lutful I.; Hasan, Mohammad M.; July 09, 2007; 7 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): NNC05AA07A; WBS 119103.04.01.03.03
Report No.(s): 2007-01-3178; Copyright; Avail.: Other Sources

The use of porous media has enormous potential for thermal management and phase separation in terrestrial, micro, Lunar and Marian gravity environments. Recently, a porous media based gravity insensitive condensing heat exchanger for humidity control has been proposed and successfully demonstrated by the authors. A strongly hydrophilic porous substrate is essential for condensing and trapping water vapor from the airstreams. However, most porous media which have good thermal characteristics are poorly wetting to water. This poses a significant obstacle in the development of the porous media based condensing heat exchanger. In response to this problem, a clay based process was developed for improving the wettability of non-wetting and partially wetting porous media. It was demonstrated that poorly wetting porous graphite as well as porous stainless steel could be converted to a completely wetting porous substrate by kaolinite treatment. The process enhances the wettability of both the surface and the interior pores. The paper presents experimental results of enhanced wettability of the treated substrate in terms of imbibition rate and capillary pressure as a function of saturation. The long term stability of the treated surface is also investigated and discussed.
Author
Kaolinite; Porosity; Substrates; Media; Chemical Properties; Porous Materials; Wettability

20070031828 NASA Langley Research Center, Hampton, VA, USA

Evaluation of a Highly Anticlastic Panel with Tow Overlaps

Wu, K. Chauncey; Gurdal, Zafer; [2007]; 20 pp.; In English; 22nd Annual Technical Conference of the American Society for Composites, 17-19 Sep. 2007, Seattle, WA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 23-064-30-34; Copyright; Avail.: CASI: A03, Hardcopy

A rectangular, variable-stiffness panel with tow overlaps was manufactured using an advanced tow placement machine. The cured panel had large anticlastic imperfections, with measured amplitudes of over two times the average panel thickness. These imperfections were not due to the overall steered-fiber layup or the tow overlaps, but instead resulted from local asymmetries in the laminate that were caused by a manufacturing oversight. In the nominal panel layup, fiber angles vary linearly from 60 degrees on the panel axial centerline to 30 degrees on the parallel edges. A geometrically nonlinear analysis was performed with a -280 degree Fahrenheit thermal load to simulate the postcure cooldown to room temperature. The predicted geometric imperfections correlated well with the measured panel shape. Unique structural test fixtures were then developed which greatly reduced these imperfections, but they also caused prestresses in the panel. Surface imperfections measured after the panel was installed in the test fixtures were used with nonlinear finite element analyses to predict these fixturing-induced prestresses. These prestresses were also included in structural analyses of panel end compression to failure, and the analytical results compared well with test data when both geometric and material nonlinearities were included.

Author

Composite Materials; Structural Analysis; Rectangular Panels; Stiffness; Defects

20070031873 NASA Langley Research Center, Hampton, VA, USA

An Improved Technique for the Preparation of Mounted or Unmounted Carbon/Epoxy Specimens

Edahl, Robert A., Jr.; July 30, 2007; 2 pp.; In English; Microscopy and Microanalysis 2006, 30 Jul. - 3 Aug. 2006, Chicago, IL, USA; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 561581.02.08.07

Report No.(s): MandM-00000427; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031873

As carbon/epoxy materials became more prevalent in the aerospace industry, microstructural analysis demanded specimen preparation techniques that led to better polished surfaces, achievable in a shorter time, and using fewer steps. The desire to use image analysis for material characterization also helped drive the goal for defect free surfaces. At NASA-Langley (LaRC), carbon/epoxy specimens had been historically prepared in 1 inch diameter Bakelite mounts. Carbon/epoxy specimens that were 1/8 to 1/4 inch thick were not affected by the heat and pressure required for mounting in Bakelite, however thinner specimens were crushed during mounting. A two-part room temperature curing epoxy was chosen as an alternative but sometimes voids developed between the specimen and the mounting material. This was prevented by either heating the epoxy to 140 degrees F to lower the viscosity of the epoxy or by using a vacuum impregnation apparatus. Both techniques helped facilitate flow and allowed the epoxy to penetrate crevices.

Derived from text

Epoxy Matrix Composites; Mounting; Curing; Microstructure; Ceramics

20070031922 NASA Langley Research Center, Hampton, VA, USA

Hypervelocity Impact (HVI), Volume 3, WLE Small-Scale Fiberglass Panel Flat Target C-1

Gorman, Michael R.; Ziola, Steven M.; September 2007; 74 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06

Report No.(s): NASA/CR-2007-214885/VOL3; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031922

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Target C-1 was to study hypervelocity impacts on the reinforced carbon-carbon (RCC) panels of the Wing Leading Edge. Fiberglass was used in place of RCC in the initial tests. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.

Author

Hypervelocity Impact; Wings; Leading Edges; Panels; Glass Fibers; Targets; Carbon-Carbon Composites

20070031925 NASA Langley Research Center, Hampton, VA, USA

Hypervelocity Impact (HVI), Volume 6, WLE High Fidelity Specimen Fg(RCC)-2

Gorman, Michael R.; Ziola, Steven M.; September 2007; 131 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06

Report No.(s): NASA/CR-2007-214885/VOL6; No Copyright; Avail.: CASI: A07, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031925

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Target Fg(RCC)-2 was to study hypervelocity impacts through the reinforced carbon-carbon (RCC) panels of the Wing Leading Edge. Fiberglass was used in place of RCC in the initial tests. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.

Author

Carbon-Carbon Composites; Hypervelocity Impact; Leading Edges; Wings; Space Shuttles; Panels; Impact Tests

20070031956 NASA Marshall Space Flight Center, Huntsville, AL, USA

Ultra-High Temperature Materials Characterization for Propulsion Applications

Rogers, Jan; Hyers, Robert; May 14, 2007; 1 pp.; In English; 54th JANNAF Propulsion Meeting, 14-17 May 2007, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Propulsion system efficiency increases as operating temperatures are increased. Some very high-temperature materials are being developed, including refractory metal alloys, carbides, borides, and silicides. System design requires data for materials properties at operating temperatures. Materials property data are not available for many materials of interest at the desired operating temperatures (up to approx. 3000 K). The objective of this work is to provide important physical property data at ultra-high temperatures. The MSFC Electrostatic levitation (ESL) facility can provide measurements of thermophysical properties which include: creep strength, density and thermal expansion for materials being developed for propulsion applications. The ESL facility uses electrostatic fields to position samples between electrodes during processing and characterization studies. Because the samples float between the electrodes during studies, they are free from any contact with a container or test apparatus. This provides a high purity environment for the study of high-temperature, reactive materials. ESL can be used to process a wide variety of materials including metals, alloys, ceramics, glasses and semiconductors. The MSFC ESL has provided non-contact measurements of properties of materials up to 3400 C. Density and thermal expansion are measured by analyzing digital images of the sample at different temperatures. Our novel, non-contact method for measuring creep uses rapid rotation to deform the sample. Digital images of the deformed samples are analyzed to obtain the creep properties, which match those obtained using ASTM Standard E-139 for Nb at 1985 C. Data from selected ESL-based characterization studies will be presented. The ESL technique could support numerous propulsion technologies by advancing the knowledge base and the technology readiness level for ultra-high temperature materials. Applications include non-eroding nozzle materials and lightweight, high-temperature alloys for turbines and structures.

Author

Heat Resistant Alloys; Operating Temperature; System Effectiveness; Systems Engineering; Thermophysical Properties; Propulsive Efficiency; Refractory Materials

20070031963 NASA Marshall Space Flight Center, Huntsville, AL, USA

Damage Tolerance of Composites

Hodge, Andy; June 25, 2007; 32 pp.; In English; National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031963

Fracture control requirements have been developed to address damage tolerance of composites for manned space flight hardware. The requirements provide the framework for critical and noncritical hardware assessment and testing. The need for

damage threat assessments, impact damage protection plans, and nondestructive evaluation are also addressed. Hardware intended to be damage tolerant have extensive coupon, sub-element, and full-scale testing requirements in-line with the Building Block Approach concept from the MIL-HDBK-17, Department of Defense Composite Materials Handbook.
Author
Composite Materials; Damage Assessment; Nondestructive Tests; Impact Damage; Manned Space Flight

20070032674 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Surface Control of Cold Hibernated Elastic Memory Self-Deployable Structure
Sokolowski, Witold M.; Ghaffarian, Reza; February 26, 2006; 11 pp.; In English; Smart Structures and Materials, NDE for Health Monitoring and Diagnostics, 26 Feb. - 2 Mar. 2006, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40222

A new class of simple, reliable, lightweight, low packaging volume and cost, self-deployable structures has been developed for use in space and commercial applications. This technology called 'cold hibernated elastic memory' (CHEM) utilizes shape memory polymers (SMP)in open cellular (foam) structure or sandwich structures made of shape memory polymer foam cores and polymeric composite skins. Some of many potential CHEM space applications require a high precision deployment and surface accuracy during operation. However, a CHEM structure could be slightly distorted by the thermo-mechanical processing as well as by thermal space environment Therefore, the sensor system is desirable to monitor and correct the potential surface imperfection. During these studies, the surface control of CHEM smart structures was demonstrated using a Macro-Fiber Composite (MFC) actuator developed by the NASA LaRC and US Army ARL. The test results indicate that the MFC actuator performed well before and after processing cycles. It reduced some residue compressive strain that in turn corrected very small shape distortion after each processing cycle. The integrated precision strain gages were detecting only a small flat shape imperfection indicating a good recoverability of original shape of the CHEM test structure.
Author
Smart Structures; Sandwich Structures; Actuators; Fiber Composites; Aerospace Environments; Compressibility; Deployment

20070032686 NASA Johnson Space Center, Houston, TX, USA; Missouri Univ., Columbia, MO, USA
Condition Assessment of Kevlar Composite Materials Using Raman Spectroscopy
Washer, Glenn; Brooks, Thomas; Saulsberry, Regor; July 22, 2007; 48 pp.; In English; Review of Progress in Quantitative Nondestructive Evaluation, 22-27 Jul. 2007, Golden, CO, USA; Original contains color illustrations; Copyright; Avail.:
CASI: A03, Hardcopy

This viewgraph presentation includes the following main concepts. Goal: To evaluate Raman spectroscopy as a potential NDE tool for the detection of stress rupture in Kevlar. Objective: Test a series of strand samples that have been aged under various conditions and evaluate differences and trends in the Raman response. Hypothesis: Reduction in strength associated with stress rupture may manifest from changes in the polymer at a molecular level. If so, than these changes may effect the vibrational characteristics of the material, and consequently the Raman spectra produced from the material. Problem Statement: Kevlar composite over-wrapped pressure vessels (COPVs) on the space shuttles are greater than 25 years old. Stress rupture phenomena is not well understood for COPVs. Other COPVs are planned for hydrogen-fueled vehicles using Carbon composite material. Raman spectroscopy is being explored as an non-destructive evaluation (NDE) technique to predict the onset of stress rupture in Kevlar composite materials. Test aged Kevlar strands to discover trends in the Raman response. Strength reduction in Kevlar polymer will manifest itself on the Raman spectra. Conclusions: Raman spectroscopy has shown relative changes in the intensity and FWHM of the ~1613 cm(exp -1) peak. Reduction in relative intensity for creep, fleet leader, and ESA specimens compared to the virgin strands. Increase in FWHM has been observed for the creep and fleet leader specimens compared to the virgin strands. Changes in the Raman spectra may result from redistributing loads within the material due to the disruption of hydrogen bonding between crystallites or defects in the crystallites from aging the Kevlar strands. Peak shifting has not been observed to date. Analysis is ongoing. Stress measurements may provide a tool in the short term.
Derived from text
Composite Materials; Kevlar (Trademark); Nondestructive Tests; Pressure Vessels; Raman Spectroscopy; Strands; Aging (Materials)

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*.

20070031830 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Radical Pathway for Organic Phosphorylation during Schreibersite Corrosion with Implications for the Origin of Life
Pasek, Matthew A.; Dworkin, Jason P.; Lauretta, Dante S.; [2007]; 45 pp.; In English
Contract(s)/Grant(s): NAG5-13470; No Copyright; Avail.: CASI: A03, Hardcopy

Phosphorylated compounds (e.g. DNA, RNA, phospholipids, and many coenzymes) are critical to biochemistry. Thus, their origin is of prime interest to origin of life studies. The corrosion of the meteoritic mineral schreibersite ((Fe,Ni)3P) may have significantly contributed to the origin of phosphorylated biomolecules. Corrosion of synthetic schreibersite in a variety of solutions was analyzed by nuclear magnetic resonance spectroscopy, mass spectrometry, and electron paramagnetic resonance spectroscopy. These methods suggest a radical reaction pathway for the corrosion of schreibersite to form phosphite radicals (raised dot PO3 sup 2-)) aqueous solution. These radicals can form activated polyphosphates and can phosphorylate organic compounds such as acetate (3% yield). Phosphonates (O3P-C) are found in the organic P inventory of the carbonaceous meteorite Murchison. While phosphonates are rare in biochemistry, the ubiquity of corroding iron meteorites on the early Earth could have provided an accessible source of organophosphorous for the origin of life allowing the invention of the organophosphates in modern biology as a product of early evolution.
Author
Corrosion; Organic Phosphorus Compounds; Phosphorylation; Radicals; Schreibersite; Life Sciences; Geochemistry

20070032646 NASA Marshall Space Flight Center, Huntsville, AL, USA
Vacuum Strength of Two Candidate Glasses for a Space Observatory
Manning, Timothy Andrew; Tucker, Dennis S.; Herren, Kenneth A.; Gregory, Don A.; [2007]; 8 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

The strengths of two candidate glass types for use in a space observatory were measured. Samples of ultra-low expansion glass (ULE) and borosilicate (Pyrex) were tested in air and in vacuum at room temperature (20 degrees C) and in vacuum after being heated to 200 degrees C. Both glasses tested in vacuum showed a significant increase in strength over those tested in air. However, there was no statistical difference between the strength of samples tested in vacuum at room temperature and those tested in vacuum after heating to 200 degrees C.
Author
Observatories; Vacuum Systems; Borosilicate Glass

26
METALS AND METALLIC MATERIALS

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

20070031770 Army Research Lab., Hampton, VA, USA
Investigation of Selectively-Reinforced Metallic Lugs
Farley, Gary L.; Abada, Christopher H.; August 2007; 39 pp.; In English; Original contains color and black and white illustrations
Report No.(s): NASA/TM-2007-214896; ARL-TR-4137; L-19372; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031770

An investigation of the effects of material and geometric variables on the response of U-shaped band-reinforced metallic lugs was performed. Variables studied were reinforcement, adhesive and metallic lug mechanical properties, hole diameter, reinforcement and adhesive thickness, and the distance from the hole s center to the end of the lug. Generally, U-shaped band reinforced lugs exhibited superior performance than non-reinforced lugs, that is higher load at the conventional lug design criteria of four percent hole elongation. Depending upon the reinforcement configuration the increase in load may be negligible to 15 or 20 percent. U-shaped band reinforcement increases lug load carrying capability primarily through two

mechanisms; increasing the slope of the response curve after the initial knee and restraining overall deformation of the metallic portion of the lug facilitating increased yielding of metallic material between the hole and the edge of the metallic portion of the lug.
Author
Mechanical Properties; Design Analysis; Lugs; Loads (Forces); Hole Geometry (Mechanics); Aluminum; Deformation

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*.

20070032040 NASA Marshall Space Flight Center, Huntsville, AL, USA
Ignition Characterization Test Results for the LO2/Ethanol Propellant Combination
Robinson, Philip J.; Popp, Christopher G.; veith, Eric M.; May 14, 2007; 2 pp.; In English; 54th JANNAF JPM Joint Meeting, 14-17 May 2007, Denver, CO, USA
Contract(s)/Grant(s): NAS8-01109; No Copyright; Avail.: Other Sources; Abstract Only

A series of contracts were issued by the Marshall Space Flight Center (MSFC) of the National Aeronautics and Space Administration (NASA) under the auspices of the Exploration Systems Mission Directorate to develop and expand the maturity of candidate technologies considered to be important for future space exploration. One such technology was to determine the viability of incorporating non-toxic propellants for Reaction Control Subsystems (RCS). Contract NAS8-01109 was issued to Aerojet to develop a dual thrust Reaction Control Engine (RCE) that utilized liquid oxygen and ethanol as the propellants. The dual thrust RCE incorporated a primary thrust level of 870 lbf, and a vernier thrust level of 10 - 30 lbf. The preferred RCS approach for the dual thrust RCE was to utilize pressure-fed liquid oxygen (LOX) and ethanol propellants; however, previous dual thrust feasibility testing incorporated GOX/Ethanol igniters as opposed to LOX/Ethanol igniters in the design. GOX/Ethanol was easier to ignite, but this combination had system design implications of providing GOX for the igniters. A LOX/Ethanol igniter was desired; however, extensive LOX/Ethanol ignition data over the anticipated operating range for the dual thrust RCE did not exist. Therefore, Aerojet designed and tested a workhorse LOX igniter to determine LOX/Ethanol ignition characteristics as part of a risk mitigation effort for the dual thrust RCE design. The objective of the ignition testing was to demonstrate successful ignition from GOX to LOX, encompassing potential two-phase flow conditions anticipated being present in real mission applications. A workhorse igniter was designed to accommodate the full LOX design flowrate, as well as a reduced GOX flowrate. It was reasoned that the initial LOX flow through the igniter would flash to GOX due to the latent heat stored in the hardware, causing a reduced oxygen flowrate because of a choked, or sonic, flow condition through the injection elements. As LOX flow continued, the hardware would chill-in, with the injected oxygen flow transitioning from cold GOX through two'phase flow to subcooled LOX. The Workhorse igniter was well instrumented: Pressure and temperature instrumentation permitted oxygen state points to be determined in the igniter oxidizer manifold, and gas-side igniter chamber thermocouples provided chamber thermal profile characteristics. The cold flow chamber pressure (Pc) for each test was determined and coupled with the igniter chamber diameter (De) to calculate the characteristic quench parameter (Pc x Dc), which was plotted as a function of core mixture ratio, MRc. Ignition limits were determined over a broad range of valve inlet conditions, and ignition was demonstrated with oxygen inlet conditions that ranged from subcooled 210 deg R LOX to 486 deg R GOX. Once ignited at cold GOX conditions, combustion was continuous as the hardware chilled in and the core mixture ratio transitioned from values near 1.0 to over 12.5. Pulsing is required in typical RCS engines; therefore, the workhorse igniter was pulse tested to verify the ability to provide the required ignition for a pulsing RCE. The minimum electrical pulse width (EPW) of the dual thrust RCE was 0.080 seconds. Igniter pulse tests were performed at three conditions: (1) an EPW of 0.080 seconds at 25% duty cycle for 400 pulses; (2) an EPW of 0.160 seconds and a 5% duty cycle for 124 pulses; (3) an EPW of 0.160 seconds and a 50% duty cycle for 380 pulses. Successful ignition of LOX/Ethanol was demonstrated over a broad range of valve inlet conditions, with the empirically determined LOX/Ethanol ignition limits extending the previous database established for GOX/Ethanol ignition limits. Although the observed chill-in characteristics of the hardware varied significantly with flowrate, ignition was readily achieved. Combustion was marginal at extremely fuel-rich conditions, and it fluctuated as the oxygen passed rough the twophase flow regime during the period of hardware chill-in. Pulse testing showed good repeatability with 100 percent re-ignition for all pulses. Certain pulse-to-pulse repeatability requirements

for actual RCS operation may necessitate establishment of minimum oxygen flow rates and engine thrust levels for satisfactory engine performance.
Author
Ethyl Alcohol; Igniters; Ignition; Liquid Oxygen; Combustion Physics; Propellant Combustion

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*.

20070031769 NASA Langley Research Center, Hampton, VA, USA
Qualification Testing of Laser Diode Pump Arrays for a Space-Based 2-micron Coherent Doppler Lidar
Amzajerdian, Farzin; Meadows, Byron L.; Baker, Nathaniel R.; Barnes, Bruce W.; Singh, Upendra N.; Kavaya, Michael J.; July 08, 2007; 4 pp.; In English; 14th Coherent Laser Radar Conference, 8-13 July 2007, Snowmass, CO, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031769

The 2-micron thulium and holmium-based lasers being considered as the transmitter source for space-based coherent Doppler lidar require high power laser diode pump arrays operating in a long pulse regime of about 1 msec. Operating laser diode arrays over such long pulses drastically impact their useful lifetime due to the excessive localized heating and substantial pulse-to-pulse thermal cycling of their active regions. This paper describes the long pulse performance of laser diode arrays and their critical thermal characteristics. A viable approach is then offered that allows for determining the optimum operational parameters leading to the maximum attainable lifetime.
Author
Doppler Radar; Thulium; Holmium; Transmitters; Thermal Cycling Tests; High Power Lasers; Pulsed Lasers; Performance Tests

20070031808 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA; Air Force Research Lab., USA
Antenna Autocalibration and Metrology Approach for the AFR/JPL Space-Based Radar
McWatters, Dalia; Michel, Thierry; Freedman, Adam; Cable, Vaughn; April 26, 2003; 5 pp.; In English; IEEE Radar Conference, 26-29 Apr., Philadelphia, PA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40184

The Air Force Research Laboratory (AFRL) and the Jet Propulsion Laboratory (JPL) are collaborating in the technology development for a space based radar (SBR) system that would feature a large aperture lightweight antenna for a joint mission later in this decade.
Author
Antennas; Calibrating; Military Technology; Space Based Radar; Metrology; Apertures

20070032056 NASA Glenn Research Center, Cleveland, OH, USA
An Overview of Antenna R&D Efforts in Support of NASA's Space Exploration Vision
Manning, Robert M.; [2007]; 47 pp.; In English; Military Antennas 2007, 26-28 Sep. 2007, Washington, DC, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 439432.04.17.01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032056

This presentation reviews the research and development work being conducted at Glenn Research Center in the area of antennas for space exploration. In particular, after reviewing the related goals of the agency, antenna technology development at GRC is discussed. The antennas to be presented are large aperture inflatable antennas, phased array antennas, a 256 element Ka-band antenna, a ferroelectric reflectarray antenna, multibeam antennas, and several small antennas.
Author
Space Exploration; Antenna Arrays; Research and Development; Large Space Structures; Microwave Antennas; Reflector Antennas; Phased Arrays

20070032062 NASA Langley Research Center, Hampton, VA, USA

Coherent Lidar Activities at NASA Langley Research Center

Kavaya, Michael J.; Amzajerdian, Farzin; Koch, Grady J.; Singh, Upendra N.; Yu, Jirong; July 08, 2007; 4 pp.; In English; 14th Coherent Laser Radar Conference, 8-13 Jul. 2007, Snowmass, CO, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 478643.02.02.02.09; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032062

NASA Langley Research Center has been developing and using coherent lidar systems for many years. The current projects at LaRC are the Global Wind Observing Sounder (GWOS) mission preparation, the Laser Risk Reduction Program (LRRP), the Instrument Incubator Program (IIP) compact, rugged Doppler wind lidar project, the Autonomous precision Landing and Hazard detection and Avoidance Technology (ALHAT) project for lunar landing, and the Skywalker project to find and use thermals to extend UAV flight time. These five projects encompass coherent lidar technology development; characterization, validation, and calibration facilities; compact, rugged packaging; computer simulation; trade studies; data acquisition, processing, and display development; system demonstration; and space mission design. This paper will further discuss these activities at LaRC.

Derived from text

Optical Radar; Coherent Radar; Wind Measurement; Earth Sciences; Sensors; Test Facilities; Fabrication

20070032633 NASA Glenn Research Center, Cleveland, OH, USA

Investigating Holey Metamaterial Effects in Terahertz Traveling-Wave Tube Amplifier

Starinshak, David P.; Wilson, Jeffrey D.; Chevalier, Christine T.; September 2007; 16 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 953033.01.03.045

Report No.(s): NASA/TP-2007-214701; E-15902; Copyright; Avail.: CASI: A03, Hardcopy

Applying subwavelength holes to a novel traveling-wave tube amplifier is investigated. Plans to increase the on-axis impedance are discussed as well as optimization schemes to achieve this goal. Results suggest that an array of holes alone cannot significantly change the on-axis electric field in the vicinity of the electron beam. However, models of a beam tunnel with corrugated walls show promise in maximizing the amplifier s on-axis impedance. Additional work is required on the subject, and suggestions are made to determine research directions.

Author

Traveling Waves; Amplifiers; Mathematical Models; Hole Geometry (Mechanics)

20070032643 NASA Marshall Space Flight Center, Huntsville, AL, USA

The ALTAIR Meteor Measurements Program

Cooke, William J.; June 11, 2007; 1 pp.; In English; Meteoroid 2007 Conference, 11-16 Jun. 2007, Barcelona, Spain; No Copyright; Avail.: Other Sources; Abstract Only

Established in late 2006, the Meteor Measurements Program is in the process of using the ALTAIR radar located on Kwajelein Atoll to obtain radar observations of sporadic and shower meteoroids. The goals are to determine meteoroid masses, orbits, ballistic coefficients and densities, which shall be provided to the Meteoroid Environment Office (MEO) at Marshall Space Flight Center. These data and analyses shall then be used by the MEO to 1) Add a realistic density distribution to the new Meteoroid Engineering Model (MEM), which is the specified environment for vehicle design in the NASA Constellation (return to Moon) program. This program is the implementation of President Bush's Vision for Space Exploration (VSE). 2) Investigate the meteoroid velocity distribution at smaller masses. 3) Strive to understand the differences (biases) in meteoroid observations produced by systems like ALTAIR and those of the meteor patrol radars, such as the University of Western Ontario's CMOR system. This paper outlines the program details and its progress.

Author

Meteoroids; Meteoroid Concentration; Radar Astronomy; Astronomical Models; Space Observations (From Earth)

20070032671 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Deployment of the MARSIS Radar Antennas On-Board Mars Express

Denis, Michel; Moorhouse, A.; Smith, A.; McKay, Mike; Fischer, J.; Jayaraman, P.; Mounzer, Z.; Schmidt, R.; Reddy, J.; Ecale, E.; Horttor, R.; Adams, D.; Flamini, E.; June 19, 2006; 18 pp.; In English; Space Operations Conference, 19-23 Jun. 2006, Rome, Italy; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40225

On the first European planetary mission, the deployment of the two 20-meter long MARSIS antennas onboard the ESA

Mars Express spacecraft has represented an unprecedented technological challenge, in the middle of a successful science mission. While Mars Express was already performing regular observations at Mars, a complex process has been performed on Earth, involving the ESA Project, coordination between ESA, NASA and ASI, the Mars Science community, the spacecraft manufacturer EADS Astrium and the Mission Control Centre at ESOC. This paper describes the steps that led from an initial nogo in 2004 to deployment one year later, as well as the conditions and difficulties encountered during the actual deployment. It provides insights in the technical and managerial processes that made it a success, and analyses the rationale behind the decisions.
Author
Space Missions; Radar Antennas; European Space Agency; ESA Spacecraft

20070032672 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Application and Operations Concepts of Large Transmit Phased Array of Parabolic Reflectors
Amoozegar, Farid; March 6, 2006; 19 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains color and black and white illustrations
Report No.(s): IEEEAC Paper-1570; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40224

The primary motive for large transmit array of parabolic reflectors, also known as Uplink Array, was to explore alternate methods in order to replace the large 70m antennas of Deep Space Network (DSN) such that the core capability for emergency support to a troubled spacecraft in deep space is preserved. Given that the Uplink Array is a new technology, the focus has always been on its feasibility and phase calibration techniques, which by itself is quite a challenge. It would be interesting to examine, however, what else could be accomplished by the Uplink Array capability other than the emergency support to a troubled spacecraft in deep space. ... The objective of this paper is to discuss a few application scenarios and the corresponding operation concepts, such as lunar positioning system, high EIRP uplink and the synergies with solar radar, and high power RF beams.
Author
Antenna Arrays; Parabolic Reflectors; Transmission Efficiency; Radio Frequencies; Deep Space Network; Calibrating; Phased Arrays

20070032673 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
UAVSAR: A New NASA Airborne SAR System for Science and Technology Research
Rosen, Paul A.; Hensley, Scott; Wheeler, Kevin; Sadowy, Greg; Miller, Tim; Shaffer, Scott; Muellerschoen, Ron; Jones, Cathleen; Zebker, Howard; Madsen, Soren; April 24, 2006; 9 pp.; In English; IEEE Radar Conference, 24-27 Apr. 2006, Verona, NY, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40223

NASA's Jet Propulsion Laboratory is currently building a reconfigurable, polarimetric L-band synthetic aperture radar (SAR), specifically designed to acquire airborne repeat track SAR data for differential interferometric measurements. Differentian interferometry can provide key deformation measurements, important for studies of earthquakes, volcanoes and other dynamically changing phenomena. Using precision real-time GPS and a sensor controlled flight management system, the system will be able to fly predefined paths with great precision. The expected performance of the flight control system will constrain the flight path to be within a 10 m diameter tube about the desired flight track. The radar will be designed to be operable on a UAV (Unpiloted Aria1 Vehicle) but will initially be demonstrated on a NASA Gulfstream III. The radar will be fully polarimetric, with a range bandwidth of 80 MHz (2 m range resolution), and will support a 16 km range swath. The antenna will be electronically steered along track to assure that the antenna beam can be directed independently, regardless of the wind direction and speed. Other features supported by the antenna include elevation monopulse and pulse-to-pulse re-steering capabilities that will enable some novel modes of operation. The system will nominally operate at 45,000 ft (13800 m). The program began as an Instrument Incubator Project (IIP) funded by NASA Earth Science and Technology Office (ESTO).
Author
Synthetic Aperture Radar; Interferometry; Antenna Radiation Patterns; Global Positioning System; Flight Management Systems

20070032679 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Polarization Loss Compensation in a Laser Transceiver System

Hoffman, Jeffrey M.; Page, Norman A.; June 4, 2006; 13 pp.; In English; International Optical Design Conference, 4 Jun. 2006, Vancouver, British Columbia, Canada; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40217

JPL is developing a polarization-based sky tracking laser transceiver system in which some mirror coatings produce significant polarization losses that vary with tracking angle. We describe a useful method for dynamically compensating these effects.

Author

Transmitter Receivers; Laser Applications; Coatings; Polarization

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*.

20070031786 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Reconfiguration of Analog Electronics for Extreme Environments

Stoica, Adrian; Zebulum, Ricardo; Keymeulen, Didier; Guo, Xin; May 5, 2005; 8 pp.; In English; SASM 2005 (Celebrating 25 years from the birth of the Seminar Gr. C Moisil and 15 years from the establishing of the Romanian Society for Fuzzy Systems and A.I.), 5-7 May 2005, Iasi, Romania; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40203

This paper argues in favor of adaptive reconfiguration as a technique to expand the operational envelope of analog electronics for extreme environments (EE). On a reconfigurable device, although component parameters change in EE, as long as devices still operate, albeit degraded, a new circuit design, suitable for new parameter values, may be mapped into the reconfigurable structure to recover the initial circuit function. Laboratory demonstrations of this technique were performed by JPL in several independent experiments in which bulk CMOS reconfgurable devices were exposed to, and degraded by, high temperatures (approx.300 C) or radiation (300kRad TID), and then recovered by adaptive reconfiguration using evolutionary search algorithms.

Author

Reconfigurable Hardware; Analog Circuits; CMOS

20070031807 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Tunable All-Solid-State Local Oscillators to 1900 GHz

Ward, John; Chattopadhyay, Goutam; Maestrini, Alain; Schlecht, Erich; Gill, John; Javadi, Hamid; Pukala, David; Maiwald, Frank; Mehdi, Imran; April 27, 2004; 8 pp.; In English; 15th International Symposium on Space TeraHertz Technology (STT), 27-29 Apr. 2004, Amherst, MA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40186

We present a status report of an ongoing effort to develop robust tunable all-solid-state sources up to 1900 GHz for the Heterodyne Instrument for the Far Infrared (HIFI) on the Herschel Space Observatory. GaAs based multi-chip power amplifier modules at W-band are used to drive cascaded chains of multipliers. We have demonstrated performance from chains comprised of four doublers up to 1600 GHz as well as from a x2x3x3 chain to 1900 GHz. Measured peak output power of 23 (micro)W at 1782 GHz and 2.6 (micro)W at 1900 GHz has been achieved when the multipliers are cooled to 120K. The 1900 GHz tripler was pumped with a four anode tripler that produces a peak of 4 mW at 630 GHz when cooled to 120 K. We believe that these sources can now be used to pump hot electron bolometer (HEB) heterodyne mixers.ter (HEB) heterodyne mixers.

Author

Solid State; Heterodyning; Far Infrared Radiation; Gallium Arsenides; Power Amplifiers; Modules

20070031809 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Extreme Temperature Electronics Using a Reconfigurable Analog Array

Zebulum, Ricardo S.; Rejeshuni, Ramesham; Keymeulen, Didier; Daud, Taher; Neff, Joseph; Stoica, Adrian; March 4, 2006; 7 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40193

Temperature and radiation tolerant electronics, as well as long life survivability are key capabilities required for future NASA missions. Current approaches to electronics for extreme environments focus on component level robustness and hardening. Compensation techniques such as bias cancellation circuitry have also been employed. However, current technology can only ensure very limited lifetime in extreme environments. Previous work presented a novel approach, based on evolvable hardware technology, which allows adaptive in-situ circuit redesign/reconfiguration during operation in extreme environments. This technology would complement material/device advancements and increase the mission capability to survive harsh environments. This work describes a new reconfigurable analog chip developed by JPL and SPAWAR that is targeted for extreme temperature and evolutionary hardware experiments. Being based on Gm-C technology, this chip can have its functionality tuned and adapted to extreme temperatures through voltage bias adjustment. This tuning process will be controlled by Evolutionary Algorithms. This paper presents details of the reconfigurable analog chip as well as a system level overview. Some early experiments are also described.

Author

Electric Potential; Evolvable Hardware; Reconfigurable Hardware; Robustness (Mathematics); Algorithms

20070031812 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

A Study of Phased Array Antennas for NASA's Deep Space Network

Jamnejad, Vahraz; Huang, John; Cesarone, Robert J.; September 19, 2001; 22 pp.; In English; Antenna Applications Symposium, 19-21 Sep. 2001, Monticello, IL, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40191

In this paper we briefly discuss various options but focus on the feasibility of the phased arrays as a viable option for this application. Of particular concern and consideration will be the cost, reliability, and performance compared to the present 70-meter antenna system, particularly the gain/noise temperature levels in the receive mode. Many alternative phased arrays including planar horizontal arrays, hybrid mechanically/electronically steered arrays, phased array of mechanically steered reflectors, multi-faceted planar arrays, phased array-fed lens antennas, and planar reflect-arrays are compared and their viability is assessed. Although they have many advantages including higher reliability, near-instantaneous beam switching or steering capability, the cost of such arrays is presently prohibitive and it is concluded that the only viable array options at the present are the arrays of a few or many small reflectors. The active planar phased arrays, however, may become feasible options in the next decade and can be considered for deployment in smaller configurations as supplementary options.

Author

Deep Space Network; Phased Arrays; Antenna Arrays; Antenna Design; Reliability; Costs; Beam Switching

20070031868 NASA Marshall Space Flight Center, Huntsville, AL, USA

Performance Measurement of a Multi-Level/Analog Ferroelectric Memory Device Design

MacLeod, Todd C.; Phillips, Thomas A.; Ho, Fat D.; May 08, 2007; 2 pp.; In English; International Symposium on Integrated Ferroelectrics, 8-11 May 2007, Bordeaux, France; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

Increasing the memory density and utilizing the unique characteristics of ferroelectric devices is important in making ferroelectric memory devices more desirable to the consumer. This paper describes the characterization of a design that allows multiple levels to be stored in a ferroelectric based memory cell. It can be used to store multiple bits or analog values in a high speed nonvolatile memory. The design utilizes the hysteresis characteristic of ferroelectric transistors to store an analog value in the memory cell. The design also compensates for the decay of the polarization of the ferroelectric material over time. This is done by utilizing a pair of ferroelectric transistors to store the data. One transistor is used a reference to determinethe amount of decay that has occurred since the pair was programmed. The second transistor stores the analog value as a polarization value between zero and saturated. The design allows digital data to be stored as multiple bits in each memory cell. The number of bits per cell that can be stored will vary with the decay rate of the ferroelectric transistors and the repeatability of polarization between transistors. This paper presents measurements of an actual prototype memory cell. This prototype is not a complete implementation of a device, but instead, a prototype of the storage and retrieval portion of an actual device.

The performance of this prototype is presented with the projected performance of the overall device. This memory design will be useful because it allows higher memory density, compensates for the environmental and ferroelectric aging processes, allows analog values to be directly stored in memory, compensates for the thermal and radiation environments associated with space operations, and relies only on existing technologies.
Author
Ferroelectric Materials; Memory (Computers); Technology Utilization; Performance Tests; Prototypes

20070031890 Old Dominion Univ., Norfolk, VA, USA
Towards a Theory of Sampled-Data Piecewise-Deterministic Markov Processes
Herencia-Zapana, Heber; Gonzalez, Oscar R.; Gray, W. Steven; December 13, 2006; 6 pp.; In English; 2006 45th IEEE Conference on Decision and Control, 13-15 Dec. 2006, San Diego, CA, USA; Original contains fold-outs or oversized pages that could not be scanned
Contract(s)/Grant(s): NNL04AA03A; NCC1-03026
Report No.(s): WeB09.2; Copyright; Avail.: Other Sources
ONLINE: http://ieeexplore.ieee.org/xpls/abs_all.jsp?isnumber=4176993&arnumber=41780

The analysis and design of practical control systems requires that stochastic models be employed. Analysis and design tools have been developed, for example, for Markovian jump linear continuous and discrete-time systems, piecewise-deterministic processes (PDP's), and general stochastic hybrid systems (GSHS's). These model classes have been used in many applications, including fault tolerant control and networked control systems. This paper presents initial results on the analysis of a sampled-data PDP representation of a nonlinear sampled-data system with a jump linear controller. In particular, it is shown that the state of the sampled-data PDP satisfies the strong Markov property. In addition, a relation between the invariant measures of a sampled-data system driven by a stochastic process and its associated discrete-time representation are presented. As an application, when the plant is linear with no external input, a sufficient testable condition for the convergence in distribution to the invariant delta Dirac measure is given.
Author
Control Systems Design; Markov Processes; Sampled Data Systems; Mathematical Models

20070031905 Science Applications International Corp., Cleveland, OH, USA
Filling the Assurance Gap on Complex Electronics
Plastow, Richard A.; August 2007; 12 pp.; In English; Second International Conference on Space Safety, 14-16 May 2007, Chicago, IL, USA
Contract(s)/Grant(s): NAS3-03140; WBS 981155.03.03.01
Report No.(s): NASA/CR-2007-214939; E-16173; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031905

Many of the methods used to develop software bare a close resemblance to Complex Electronics (CE) development. CE are now programmed to perform tasks that were previously handled by software, such as communication protocols. For example, the James Webb Space Telescope will use Field Programmable Gate Arrays (FPGAs), which can have over a million logic gates, to send telemetry. System-on-chip (SoC) devices, another type of complex electronics, can combine a microprocessor, input and output channels, and sometimes an FPGA for programmability. With this increased intricacy, the possibility of software-like bugs such as incorrect design, logic, and unexpected interactions within the logic is great. Since CE devices are obscuring the hardware/software boundary, mature software methodologies have been proposed, with slight modifications, to develop these devices. By using standardized S/W Engineering methods such as checklists, missing requirements and bugs can be detected earlier in the development cycle, thus creating a development process for CE that can be easily maintained and configurable based on the device used.
Author
Electronics; Software Reliability; Protocol (Computers); Logic Circuits; Electronic Equipment

20070031913 Science Applications International Corp., Cleveland, OH, USA
Software Process Assurance for Complex Electronics
Plastow, Richard A.; July 24, 2007; 31 pp.; In English; International Association for the Advancement of Space Safety Conference, 14-16 Mar. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-03140; WBS 981155.03.03.01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031913

Complex Electronics (CE) are now programmed to perform tasks that were previously handled in software, such as

communication protocols. Many of the methods used to develop software bare a close resemblance to CE development. For instance, Field Programmable Gate Arrays (FPGAs) can have over a million logic gates while system-on-chip (SOC) devices can combine a microprocessor, input and output channels, and sometimes an FPGA for programmability. With this increased intricacy, the possibility of software-like bugs such as incorrect design, logic, and unexpected interactions within the logic is great. Since CE devices are obscuring the hardware/software boundary, we propose that mature software methodologies may be utilized with slight modifications in the development of these devices. Software Process Assurance for Complex Electronics (SPACE) is a research project that looks at using standardized S/W Assurance/Engineering practices to provide an assurance framework for development activities. Tools such as checklists, best practices and techniques can be used to detect missing requirements and bugs earlier in the development cycle creating a development process for CE that will be more easily maintained, consistent and configurable based on the device used.
Author
Electronics; Software Reliability; Systems Engineering; Complex Systems; Multiprocessing (Computers)

20070031966 NASA Marshall Space Flight Center, Huntsville, AL, USA
On the Mutual Coupling Between Circular Resonant Slots
Abou-Khousa, M. A.; Kharkovsky, S.; Zoughi, R.; June 27, 2007; 3 pp.; In English; 3rd International Conference on Electromagnetic Near-Field Characterization and Imaging (ICONIC 2007), 27-29 Jun. 2007, Saint Louis, MO, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM06AA06G; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031966

For near- and far-field microwave imaging purposes, array of circular resonant slots can be utilized to sample the electric field at a given reference plane. In general, the sensitivity of such array probes is impaired by the mutual coupling present between the radiating elements. The mutual coupling problem poses a design tradeoff between the resolution of the array and its sensitivity. In this paper, we investigate the mutual coupling between circular resonant slots in conducting ground plane both numerically and experimentally. Based on the analysis of the dominant coupling mechanism, i.e., the surface currents, various remedies to reduce the slots' mutual coupling are proposed and verified.
Author
Slots; Far Fields; Electric Fields; Microwave Imagery

20070031970 NASA Marshall Space Flight Center, Huntsville, AL, USA
Stainless Steel NaK-Cooled Circuit (SNaKC) Fabrication and Assembly
Godfroy, Thomas J.; June 24, 2007; 1 pp.; In English; Space Nuclear Conference (SNC) 2007, 24-28 Jun. 2007, Boston, MA, USA; No Copyright; Avail.: Other Sources; Abstract Only

An actively pumped Stainless Steel NaK Circuit (SNaKC) has been designed and fabricated by the Early Flight Fission Test Facility (EFF-TF) team at NASA's Marshall Space Flight Center. This circuit uses the eutectic mixture of sodium and potassium (NaK) as the working fluid building upon the experience and accomplishments of the SNAP reactor program from the late 1960's The SNaKC enables valuable experience and liquid metal test capability to be gained toward the goal of designing and building an affordable surface power reactor. The basic circuit components include a simulated reactor core a NaK to gas heat exchanger, an electromagnetic (EM) liquid metal pump, a liquid metal flow meter, an expansion reservoir and a drain/fill reservoir To maintain an oxygen free environment in the presence of NaK, an argon system is utilized. A helium and nitrogen system are utilized for core, pump, and heat exchanger operation. An additional rest section is available to enable special component testing m an elevated temperature actively pumped liquid metal environment. This paper summarizes the physical build of the SNaKC the gas and pressurization systems, vacuum systems, as well as instrumentation and control methods.
Author
Stainless Steels; Circuits; Fabrication; Liquid Metals; Potassium; Sodium

20070032094 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Analysis of Fluid Gauge Sensor for Zero or Microgravity Conditions using Finite Element Method
Deshpande, Manohar D.; Doiron, Terence a.; [2007]; 4 pp.; In English; 2007 IEEE AP-S International Symposium, 10-15 Jun. 2007, Honolulu, HI, USA; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032094

In this paper the Finite Element Method (FEM) is presented for mass/volume gauging of a fluid in a tank subjected to

zero or microgravity conditions. In this approach first mutual capacitances between electrodes embedded inside the tank are measured. Assuming the medium properties the mutual capacitances are also estimated using FEM approach. Using proper non-linear optimization the assumed properties are updated by minimizing the mean square error between estimated and measured capacitances values. Numerical results are presented to validate the present approach.
Author
Finite Element Method; Measuring Instruments; Microgravity; Electrodes

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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*.

20070031864 NASA Marshall Space Flight Center, Huntsville, AL, USA
Flow Separation Side Loads Excitation of Rocket Nozzle FEM
Smalley, Kurt B.; Brown, Andrew; Ruf, Joseph; Gilbert, John; [2007]; 32 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 April 2007, Honolulu, HI, USA; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Modern rocket nozzles are designed to operate over a wide range of altitudes, and are also built with large aspect ratios to enable high efficiencies. Nozzles designed to operate over specific regions of a trajectory are being replaced in modern launch vehicles by those that are designed to operate from earth to orbit. This is happening in parallel with modern manufacturing and wall cooling techniques allowing for larger aspect ratio nozzles to be produced. Such nozzles, though operating over a large range of altitudes and ambient pressures, are typically designed for one specific altitude. Above that altitude the nozzle flow is 'underexpanded' and below that altitude, the nozzle flow is 'overexpanded'. In both conditions the nozzle produces less than the maximum possible thrust at that altitude. Usually the nozzle design altitude is well above sea level, leaving the nozzle flow in an overexpanded state for its start up as well as for its ground testing where, if it is a reusable nozzle such as the Space Shuttle Main Engine (SSME), the nozzle will operate for the majority of its life. Overexpansion in a rocket nozzle presents the critical, and sometimes design driving, problem of flow separation induced side loads. To increase their understanding of nozzle side loads, engineers at MSFC began an investigation in 2000 into the phenomenon through a task entitled 'Characterization and Accurate Modeling of Rocket Engine Nozzle Side Loads', led by A. Brown. The stated objective of this study was to develop a methodology to accurately predict the character and magnitude of nozzle side loads. The study included further hot-fire testing of the MC-l engine, cold flow testing of subscale nozzles, CFD analyses of both hot-fire and cold flow nozzle testing, and finite element (fe.) analysis of the MC-1 engine and cold flow tested nozzles. A follow on task included an effort to formulate a simplified methodology for modeling a side load during a two nodal diameter fluid/structure interaction for a single moment in time.
Author
Rocket Nozzles; Finite Element Method; Loads (Forces); Excitation; Computational Fluid Dynamics; Separated Flow; Nozzle Design

20070031887 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thermal Control Materials on MISSE-5 with Comparison to Earlier Flight Data
Finckenor, Miria; Zwiener, James M.; Pippin, Gary; [2007]; 27 pp.; In English; National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA
Contract(s)/Grant(s): 401769.06.03.07.02.02; Copyright; Avail.: CASI: A03, Hardcopy

A variety of thermal control materials were flown on the Materials on International Space Station Experiment (MISSE)-5. Several types of beta cloth, as used in multi-layer insulation blankets, were flown, including samples from the same batch as used on the International Space Station. Two candidate sunshade materials for the James Webb Space Telescope were also exposed on MISSE-5. The white thermal control coating AZ93 was applied to Kapton instead of aluminum; this sample maintained good solar absorptance and did not indicate any significant level of contamination to the MISSE-5 experiment. Marker coatings maintained their color. Thermo-optical properties are discussed, along with comparable data from MISSE-2 and the Passive Optical Sample Assembly (POSA) - I experiments.
Author
Multilayer Insulation; Solar Energy Absorbers; Temperature Control; International Space Station; Thermal Control Coatings

20070032054 NASA Glenn Research Center, Cleveland, OH, USA

Thermal Characterization Study of Lithium-Ion Cells

Britton, Doris L.; Miller, Thomas B.; Bennett, William R.; August 23, 2007; 26 pp.; In English; 10th Electrochemical Power Sources Symposium, 20-23 Aug. 2007, Williamsburg, VA, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 038957.04.01.02.03.03; Copyright; Avail.: CASI: A03, Hardcopy

The primary challenge in designing a full scale lithium-ion (Li-ion) battery system is safety under both normal operating as well as abusive conditions. The normal conditions involve expected charge/discharge cycles and it is known that heat evolves in batteries during those cycles. This is a major concern in the design for high power applications and careful thermal management is necessary to alleviate this concern. An emerging thermal measurement technology, such as the electrochemical calorimetric of batteries, will aid in the development of advanced, safe battery system. To support this technology, several 'commercial-off-the-shelf' (COTS) Li-ion cells with different chemistries and designs are being evaluated for different cycling regimes at a given operating temperature. The Accelerated Rate Calorimeter (ARC)-Arbin cycler setup is used to measure the temperature, voltage, and current of the cells at different charge/discharge rates. Initial results demonstrated good cell cyclability. During the cycle testing, the cell exhibited an endothermic cooling in the initial part of the charge cycle. The discharge portion of the cycle is exothermic during the entire discharge period. The presence of an endothermic reaction indicates a significant entropy effect during the beginning of charge cycle. Further studies will be performed to understand the thermal characteristics of the Li-ion cells at the different operating conditions. The effects on the thermal response on cell aging and states-of-charge will also be identified.

Author

Electric Batteries; Electric Potential; Temperature Effects; Lithium; Operating Temperature; Metal Ions; Temperature Control

20070032067 NASA Marshall Space Flight Center, Huntsville, AL, USA

Numerical Study of Flow Augmented Thermal Management for Entry and Re-Entry Environments

Cheng, Gary C.; Neroorkar, Kshitij D.; Chen, Yen-Sen; Wang, Ten-See; Daso, Endwell O.; June 25, 2007; 16 pp.; In English; 39th AIAA Thermophysics Conference, 25-28 Jun. 2007, Miami, FL, USA; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The use of a flow augmented thermal management system for entry and re-entr environments is one method for reducing heat and drag loads. This concept relies on jet penetration from supersonic and hypersonic counterflowing jets that could significantly weaken and disperse the shock-wave system of the spacecraft flow field. The objective of this research effort is to conduct parametric studies of the supersonic flow over a 2.6% scale model of the Apollo capsule, with and without the counterflowing jet, using time-accurate and steady-state computational fluid dynamics simulations. The numerical studies, including different freestream Mach number angle of attack counterflowing jet mass flow rate, and nozzle configurations, were performed to examine their effect on the drag and beat loads and to explore the counternowing jet condition. The numerical results were compared with the test data obtained from transonic blow-down wind-tunnel experiments conducted independently at NASA MSFC.

Author

Computational Fluid Dynamics; Temperature Control; Reentry; Atmospheric Entry; Scale Models; Blowdown Wind Tunnels; Apollo Spacecraft; Augmentation; Numerical Analysis

20070032678 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Novel Thermal Powered Technology for UUV Persistent Surveillance

Jones, Jack A.; Chao, Yi; February 10, 2006; 11 pp.; In English; ONR Joint Review of Unmanned Systems Technology Development, 10 Feb. 2006, Panama City, FL, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40220

Buoyancy Generation: Various technology attempts include melting a wax, which pushes directly against a piston (U.S. Patent 5,291,847) or against a bladder (Webb Research), using ammonia or Freon 21 (U.S. Patent 5,303,552), and using solar heat to expand an oil (www.space.com, April, 10, 2002). All these heat-activated buoyancy control designs have thus far proved impractical and have ultimately failed during repeated cycling in ocean testing. JPL has demonstrated fully reversible 10 C encapsulated wax phase change, which can be used to change buoyancy without electrical hydraulic pumps. This technique has greatly improved heat transfer and much better reversibility than previous designs. Power Generation: Ocean Thermal Energy Conversion (OTEC) systems have been designed that transfer deep, cold sea water to the surface to generate electricity using turbine cycles with ammonia or water as the working fluid. JPL has designed several UUV systems: 1) Using

a propeller water turbine to generate power on a gliding submersible; 2) Employing a compact CO2 turbine cycle powered by moving through thermoclines; and 3) Using melted wax to directly produce power through a piston-geared generator. Derived from text

Surveillance; Buoyancy; Ocean Thermal Energy Conversion; Heat Transfer; Melting

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*.

20070032101 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Analysis of Photogrammetry Data from ISIM Mockup

Nowak, Maria; Hill, Mike; [2007]; 13 pp.; In English; SPIE Optics and Photonics Conference, 26-30 Aug. 2007, San Diego,CA, USA; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032101

During ground testing of the Integrated Science Instrument Module (ISIM) for the James Webb Space Telescope (JWST), the ISIM Optics group plans to use a Photogrammetry Measurement System for cryogenic calibration of specific target points on the ISIM composite structure and Science Instrument optical benches and other GSE equipment. This testing will occur in the Space Environmental Systems (SES) chamber at Goddard Space Flight Center. Close range photogrammetry is a 3 dimensional metrology system using triangulation to locate custom targets in 3 coordinates via a collection of digital photographs taken from various locations and orientations. These photos are connected using coded targets, special targets that are recognized by the software and can thus correlate the images to provide a 3 dimensional map of the targets, and scaled via well calibrated scale bars. Photogrammetry solves for the camera location and coordinates of the targets simultaneously through the bundling procedure contained in the V-STARS software, proprietary software owned by Geodetic Systems Inc. The primary objectives of the metrology performed on the ISIM mock-up were (1) to quantify the accuracy of the INCA3 photogrammetry camera on a representative full scale version of the ISIM structure at ambient temperature by comparing the measurements obtained with this camera to measurements using the Leica laser tracker system and (2), empirically determine the smallest increment of target position movement that can be resolved by the PG camera in the test setup, i.e., precision, or resolution. In addition, the geometrical details of the test setup defined during the mockup testing, such as target locations and camera positions, will contribute to the final design of the photogrammetry system to be used on the ISIM Flight Structure. Author

Photogrammetry; Ground Tests; Metrology; James Webb Space Telescope; Coordinates; Photographs; Ambient Temperature

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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*.

20070031993 NASA Marshall Space Flight Center, Huntsville, AL, USA

Calculation of Dynamic Loads Due to Random Vibration Environments in Rocket Engine Systems

Christensen, Eric R.; Brown, Andrew M.; Frady, Greg P.; [2007]; 31 pp.; In English; American Institute of Aeronautics and Astronautics, Structures, Structural Dynamics, and Materials Conference, 23-27 Apr. 2007, Honolulu, HI, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

An important part of rocket engine design is the calculation of random dynamic loads resulting from internal engine 'self-induced' sources. These loads are random in nature and can greatly influence the weight of many engine components. Several methodologies for calculating random loads are discussed and then compared to test results using a dynamic testbed consisting of a 60K thrust engine. The engine was tested in a free-free condition with known random force inputs from shakers

attached to three locations near the main noise sources on the engine. Accelerations and strains were measured at several critical locations on the engines and then compared to the analytical results using two different random response methodologies.
Author
Dynamic Loads; Random Vibration; Rocket Engine Design; Engine Tests; Mechanical Engineering

38
QUALITY ASSURANCE AND RELIABILITY

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

20070032648 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Quality Assurance Role in Research and Development
Shepherd, Christena C.; [2007]; 3 pp.; In English; No Copyright; Avail.: Other Sources

There is a long history of debate concerning what involvement, if any, quality assurance should have in a research and development process. Typically, this involvement is not desired, planned for or funded until a product is nearing qualification or the beginning of production. This approach is based on three assumptions: (1) Quality Assurance will add expense to the effort when it is not needed, (2) Quality brings a set of requirements and formality that do not fit R&D, and (3) things will go much smoother if 'they' are not involved. This approach is a self-fulfilling prophesy, in that late involvement of quality professionals often leads to late problem identification, a steep learning curve, and repeat of fabrication or testing to obtain the appropriate data pedigree. These assumptions are predicated on an 'all or nothing' approach to implementing quality methods, a view of 'quality' as requirements or accept/reject functions, rather than a set of risk mitigation tools, plus a view of quality assurance as a mandate to follow a standard rather than as a service which can be tailored to the needs of the customer.
Derived from text
Quality Control; Research and Development; Product Development; Organizations

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*.

20070031763 NASA Langley Research Center, Hampton, VA, USA
Vertical Drop Testing and Analysis of the Wasp Helicopter Skid Gear
Jackson, Karen E.; Fuchs, Yvonne T.; [2007]; 35 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): WBS 877868.02.07.07.05.02
Report No.(s): NASA/TM-2007-214901; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031763

This report describes an experimental program to assess the impact performance of a skid gear for use on the Wasp kit-built helicopter, which is marketed by HeloWerks, Inc. of Hampton, Virginia. In total, five vertical drop tests were performed. The test article consisted of a skid gear mounted beneath a steel plate. A seating platform was attached to the upper surface of the steel plate, and two 95th percentile Hybrid III male Anthropomorphic Test Devices (ATDs) were seated on the platform and secured using a four-point restraint system. The test article also included ballast weights to ensure the correct position of the Center-of-Gravity (CG). Twenty-six channels of acceleration data were collected per test at 50,000 samples per second. The five drop tests were conducted on two different gear configurations. The details of these test programs are presented, as well as an occupant injury assessment. Finally, a finite element model of the skid gear test article was developed for execution in LS-DYNA, an explicit nonlinear transient dynamic code, for predicting the skid gear and occupant dynamic responses due to impact.
Author
Drop Tests; Dynamic Response; Finite Element Method; Metal Surfaces; Skidding

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*.

20070031889 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Stable Targets for Spaceborne Microwave Radiometer Calibration

Njoku, Eni G.; Chan, S. K.; Armstrong, R. L.; Brodzik, M. J.; Savoie, M. H.; Knowles, K.; February 28, 2006; 6 pp.; In English; 9th Specialist Meeting on Microwave Radiometry and Remote Sensing Applications, 28 Feb. - 3 mar. 2006, San Juan, Puerto Rico; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40182

Beginning in the 1970s, continuous observations of the Earth have been made by spaceborne microwave radiometers. Since these instruments have different observational characteristics, care must be taken in combining their data to form consistent long term records of brightness temperatures and derived geophysical quantities. To be useful for climate studies, data from different instruments must be calibrated relative to each other and to reference targets on the ground whose characteristics are stable and can be monitored continuously. Identifying such targets over land is not straightforward due to the heterogeneity and complexity of the land surface and cover. In this work, we provide an analysis of multi-sensor brightness temperature statistics over ocean, tropical forest, and ice sheet locations, spanning the period from 1978 to the present, and indicate the potential of these sites as continuous calibration monitoring targets.

Author

Microwave Radiometers; Calibrating; Brightness Temperature; Multisensor Applications

20070031898 Science Systems and Applications, Inc., Hampton, VA, USA; NASA Langley Research Center, Hampton, VA, USA

The Calibration of AVHRR Visible Dual Gain using Meteosat-8 for NOAA-16 to 18

Doelling, David R.; Garber, Donald P.; Avey, L. A.; Nguyen, Louis; Minnis, Patrick; Atmospheric and Environmental Remote Sensing Data Processing and Utilization III: Readiness for GEOSS; August 26, 2007; 11 pp.; In English; SPIE International Symposium on Optics and Photonics, 26-30 August 2007, San Diego, CA, USA; Original contains black and white illustrations

Report No.(s): SPIE 6684-8; Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://dx.doi.org/10.1117/12.736080

The NOAA AVHRR program has given the remote sensing community over 25 years of imager radiances to retrieve global cloud, vegetation, and aerosol properties. This dataset can be used for long-term climate research, if the AVHRR instrument is well calibrated. Unfortunately, the AVHRR instrument does not have onboard visible calibration and does degrade over time. Vicarious post-launch calibration is necessary to obtain cloud properties that are not biased over time. The recent AVHRR-3 instrument has a dual gain in the visible channels in order to achieve greater radiance resolution in the clear-sky. This has made vicarious calibration of the AVHRR-3 more difficult to unravel. Reference satellite radiances from well-calibrated instruments, usually equipped with solar diffusers, such as MODIS, have been used to successfully vicariously calibrate other visible instruments. Transfer of calibration from one satellite to another using co-angled, collocated, coincident radiances has been well validated. Terra or Aqua MODIS and AVHRR comparisons can only be performed over the poles during summer. However, geostationary satellites offer a transfer medium that captures both parts of the dual gain. This AVHRR-3 calibration strategy uses, calibrated with MODIS, Meteosat-8 radiances simultaneously to determine the dual gains using 50km regions. The dual gain coefficients will be compared with the nominal coefficients. Results will be shown for all visible channels for NOAA-17.

Author

Advanced Very High Resolution Radiometer; Meteosat Satellite; NOAA Satellites; Calibrating; MODIS (Radiometry); Remote Sensing; Amplification

20070031957 NASA Marshall Space Flight Center, Huntsville, AL, USA

Effects of Global Change on U.S. Urban Areas: Vulnerabilities, Impacts, and Adaptation

Quattrochi, Dale A.; Wilbanks, Thomas J.; Kirshen, Paul; Romero-Lnkao, Patricia; Rosenzweig, Cynthia; Ruth, Matthias; Solecki, William; Tarr, Joel; May 22, 2007; 2 pp.; In English; AGU Joint Conference/American Geologist Union, 22-25 may 2007, Acapulco, Mexico; Copyright; Avail.: Other Sources; Abstract Only

Human settlements, both large and small, are where the vast majority of people on the Earth live. Expansion of cities both

in population and areal extent, is a relentless process that will accelerate in the 21st century. As a consequence of urban growth both in the USA and around the globe, it is important to develop an understanding of how urbanization will affect the local and regional environment. Of equal importance, however, is the assessment of how cities will be impacted by the looming prospects of global climate change and climate variability. The potential impacts of climate change and variability has recently been annunciated by the IPCC's 'Climate Change 2007' report. Moreover, the U.S. Climate Change Science Program (CCSP) is preparing a series of 'Synthesis and Assessment Products' (SAPs) reports to support informed discussion and decision making regarding climate change and variability by policy matters, resource managers, stakeholders, the media, and the general public. We are authors on a SAP describing the effects of global climate change on human settlements. This paper will present the elements of our SAP report that relate to what vulnerabilities and impacts will occur, what adaptation responses may take place, and what possible effects on settlement patterns and characteristics will potentially arise, on human settlements in the U.S. as a result of climate change and climate variability. We will also present some recommendations about what should be done to further research on how climate change and variability will impact human settlements in the U.S., as well as how to engage government officials, policy and decision makers, and the general public in understanding the implications of climate change and variability on the local and regional levels. Additionally, we wish to explore how technology such as remote sensing data coupled with modeling, can be employed as synthesis tools for deriving insight across a spectrum of impacts (e.g. public health, urban planning for mitigation strategies) on how cities can cope and adapt to climate change and variability. This latter point parallels the concepts and ideas presented in the U.S. National Academy of Sciences, Decadal Survey report on 'Earth Science Applications from Space: National Imperatives for the Next Decade and Beyond' wherein the analysis of the impacts of climate change and variability, human health, and land use change are listed as key areas for development of future Earth observing remote sensing systems.
Author
Cities; Climate Change; Remote Sensing; Earth Sciences

20070031959 NASA Marshall Space Flight Center, Huntsville, AL, USA
Impacts of Urbanization in the Coastal Tropical City of San Juan, Puerto Rico
Comarazamy, Daniel E.; Gonzalez, Jorge E.; Luvall, Jeffrey C.; Rickman, Douglas L.; Mulero, Pedro J.; [2007]; 1 pp.; In English; To appear in Earth Interactions/American Geophysical Union; Copyright; Avail.: Other Sources; Abstract Only

Urban sprawl in tropical locations is rapidly accelerating and it is more evident in islands where a large percentage of the population resides along the coasts. This paper focuses on the analysis of the impacts of land use and land cover for urbanization in the tropical coastal city of San Juan, in the Caribbean island of Puerto Rico. A mesoscale numerical model, the Regional Atmospheric Modeling System (RAMS), is used to study the impacts of land use for urbanization in the environment including specific characteristics of the urban heat island in the San Juan Metropolitan Area (SJMA), one of the most noticeable urban cores of the Caribbean. The research also makes use of the observations obtained during the airborne San Juan Atlas Mission. Surface and rawinsonde data from the mission are used to validate the atmospheric model yielding satisfactory results. Airborne high resolution remote sensing data are used to update the model's surface characteristics in order to obtain a more accurate and detailed configuration of the SJMA and perform a climate impact analysis based on land cover/land use (LCLU) changes. The impact analysis showed that the presence of the urban landscape of San Juan has an impact reflected in higher air temperatures over the area occupied by the city, with positive values of up to 2.5 C, for the simulations that have specified urban LCLU indexes in the model's bottom boundary. One interesting result of the impact analysis was the finding of a precipitation disturbance shown as a difference in total accumulated rainfall between the present urban landscape and with a potential natural vegetation, apparently induced by the presence of the urban area. Results indicate that the urban enhanced cloud formation and precipitation development occur mainly downwind of the city, including the accumulated precipitation. This spatial pattern can be explained by the presence of a larger urbanized area in the southwest sector of the city, and of the approaching northeasterly trade winds. No significant impacts were found in the sea breeze patterns of the city.
Author
Atmospheric Models; Cities; Coasts; Mathematical Models; Puerto Rico; Remote Sensing; Topography; Tropical Regions

20070031998 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Application of NASA Remote Sensing Technology to Human Health
Watts, C. T.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

With the help of satellites, the Earth's environment can be monitored from a distance. Earth observing satellites and sensors collect data and survey patterns that supply important information about the environment relating to its affect on human health. Combined with ground data, such patterns and remote sensing data can be essential to public health

applications. Remote sensing technology is providing information that can help predict factors that affect human health, such as disease, drought, famine, and floods. A number of public health concerns that affect Earth's human population are part of the current National Aeronautics and Space Administration (NASA) Earth Science Applications Plan to provide remotely gathered data to public health decision-makers to aid in forming and implementing policy to protect human health and preserve well-being. These areas of concern are: air quality; water quality; weather and climate change; infectious, zoonotic, and vector-borne disease; sunshine; food resource security; and health risks associated with the built environment. Collaborations within the Earth Science Applications Plan join local, state, national, or global organizations and agencies as partners. These partnerships engage in projects that strive to understand the connection between the environment and health. The important outcome is to put this understanding to use through enhancement of decision support tools that aid policy and management decisions on environmental health risks. Future plans will further employ developed models in formats that are compatible and accessible to all public health organizations.
Author
Earth Sciences; Remote Sensing; Technology Utilization; Public Health; Human Beings; Earth Environment

20070032007 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Use of GIS and Remotely Sensed Data in Environmental Public Health Tracking (EPHT): The HELIX-Atlanta Experience
Crosson, William L.; Limaye, Ashutosh S.; Estes, Maurice G., Jr.; Watts, Carol; Rickman, Douglas L.; Quattrochi, Dale A.; Qualters, Judith R.; Sinclair, Amber H.; Tolsma, Dennis D.; Adeniyi, Kafayat A.; [2007]; 1 pp.; In English; URISA GIS in Public Health Conference, 20-23 May 2007, New Orleans, LA, USA; Copyright; Avail.: Other Sources; Abstract Only

As part of the National Environmental Public Health Tracking Network (EPHTN), the National Center for Environmental Health (NCEH) at the Centers for Disease Control and Prevention (CDC) is leading a project in collaboration with the NASA Marshall Space Flight Center (NASA/MSFC) called Health and Environment Linked for Information Exchange (HELIX-Atlanta). HELIX-Atlanta's goal is to examine the feasibility of building an integrated electronic health and environmental data network in five counties of metropolitan Atlanta, GA. Under HELIX-Atlanta, pilot projects are being conducted to develop methods to characterize exposure; link health and environmental data; analyze the relationship between health and environmental factors; and communicate findings. There is evidence in the research literature that asthmatic persons are at increased risk of developing asthma exacerbations with exposure to environmental factors, including PM(sub 2.5). Thus, HELIX-Atlanta is focusing on methods for characterizing population exposure to PM(sub 2.5) for the Atlanta metropolitan area that could be used in ongoing surveillance. NASA/MSFC is working with CDC to combine NASA earth science satellite observations related to air quality and environmental monitoring data to model surface estimates of fine particulate matter (PM(sub 2.5)) concentrations in a Geographic Information System (GIS) that can be linked with clinic visits for asthma on the aggregated grid level as well as the individual level at the geographic locations of the patients' residences.
Author
Diseases; Geographic Information Systems; Public Health; Remote Sensing; Tracking Networks; Environmental Quality

20070032077 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Comparison of Measurements and FluorMOD Simulations for Solar Induced Chlorophyll Fluorescence and Reflectance of a Corn Crop under Nitrogen Treatments [SIF and Reflectance for Corn]
Middleton, Elizabeth M.; Corp, Lawrence A.; Campbell, Petya K. E.; [2007]; 24 pp.; In English; Copyright; Avail.:
CASI: A03, Hardcopy

The FLuorescence Explorer (FLEX) satellite concept is one of six semifinalist mission proposals selected in 2006 for pre-Phase studies by the European Space Agency (ESA). The FLEX concept proposes to measure passive solar induced chlorophyll fluorescence (SIF) of terrestrial ecosystems. A new spectral vegetation Fluorescence Model (FluorMOD) was developed to include the effects of steady state SIF on canopy reflectance. We used our laboratory and field measurements previously acquired from foliage and canopies of corn (Zea mays L.) under controlled nitrogen (N) fertilization to parameterize and evaluate FluorMOD. Our data included biophysical properties, fluorescence (F) and reflectance spectra for leaves; reflectance spectra of canopies and soil; solar irradiance; plot-level leaf area index; and canopy SIF emissions determined using the Fraunhofer Line Depth principal for the atmospheric telluric oxygen absorption features at 688 nm (O2-beta) and 760 nm (O2-alpha). FluorMOD simulations implemented in the default 'look-up-table' mode did not reproduce the observed magnitudes of leaf F, canopy SIF, or canopy reflectance. However, simulations for all of these parameters agreed

with observations when the default FluorMOD information was replaced with measurements, although N treatment responses were underestimated. Recommendations were provided to enhance FluorMOD's potential utility in support of SIF field experiments and studies of agriculture and ecosystems.
Author
Remote Sensing; Nitrogen; Chlorophylls; Corn; Fluorescence; Reflectance; Vegetation

20070032079 NASA Stennis Space Center, Stennis Space Center, MS, USA
Regional Sediment Management (RSM) RPC Experiment
Estep, Leland; Spruce, Joseph P.; Hall, Callie; July 11, 2007; 9 pp.; In English; Mississippi Research Consortium RPC Project Review, 11 Jul. 2007, Starkville, MS, USA
Contract(s)/Grant(s): NNS04AB54T
Report No.(s): SSTI-2220-0111; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032079

The viewgraph presentation presents the background, objectives, basic methodology, validation, and present status of the Regional Sediment Management (RSM) RPC Experiment.
CASI
Sediment Transport; Data Acquisition; Remote Sensing; Soil Erosion

20070032097 NASA Goddard Space Flight Center, Greenbelt, MD, USA
NASA's NPOESS Preparatory Project Science Data Segment: A Framework for Measurement-based Earth Science Data Systems
Schwaller, Mathew R.; Schweiss, Robert J.; Juy 23, 2007; 4 pp.; In English; IGARSS 2007, 23-27 Jul. 2007, Barcelona, Spain; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032097

The NPOESS Preparatory Project (NPP) Science Data Segment (SDS) provides a framework for the future of NASA s distributed Earth science data systems. The NPP SDS performs research and data product assessment while using a fully distributed architecture. The components of this architecture are organized around key environmental data disciplines: land, ocean, ozone, atmospheric sounding, and atmospheric composition. The SDS thus establishes a set of concepts and a working prototypes. This paper describes the framework used by the NPP Project as it enabled Measurement-Based Earth Science Data Systems for the assessment of NPP products.
Author
Earth Sciences; Data Systems; Atmospheric Composition; Ozone; Atmospheric Sounding

20070032652 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Sensor Management for Applied Research Technologies (SMART) Project
Goodman, Michael; Jedlovec, Gary; Conover, Helen; Botts, Mike; Robin, Alex; Blakeslee, Richard; Hood, Robbie; Ingenthron, Susan; Li, Xiang; Maskey, Manil; Stephens, Karen; [2007]; 5 pp.; In English; NASA Science Technology Conference, 19-21 Jun. 2007, Adelphi, MD, USA; Copyright; Avail.: CASI: A01, Hardcopy

NASA seeks on-demand data processing and analysis of Earth science observations to facilitate timely decision-making that can lead to the realization of the practical benefits of satellite instruments, airborne and surface remote sensing systems. However, a significant challenge exists in accessing and integrating data from multiple sensors or platforms to address Earth science problems because of the large data volumes, varying sensor scan characteristics, unique orbital coverage, and the steep 'learning curve' associated with each sensor, data type, and associated products. The development of sensor web capabilities to autonomously process these data streams (whether real-time or archived) provides an opportunity to overcome these obstacles and facilitate the integration and synthesis of Earth science data and weather model output.
Author
Remote Sensing; Technology Utilization; Earth Sciences; Algorithms

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ENVIRONMENT POLLUTION

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

20070032692 NASA Marshall Space Flight Center, Huntsville, AL, USA
Land Surface Process and Air Quality Research and Applications at MSFC
Quattrochi, Dale; Khan, Maudood; June 18, 2007; 22 pp.; In English; NASA Applied Sciences Air Quality Applications Program Meeting, 18-20 Jun. 2007, Potomac, MD, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032692

This viewgraph presentation provides an overview of land surface process and air quality research at MSFC including atmospheric modeling and ongoing research whose objective is to undertake a comprehensive spatiotemporal analysis of the effects of accurate land surface characterization on atmospheric modeling results, and public health applications. Land use maps as well as 10 meter air temperature, surface wind, PBL mean difference heights, NOx, ozone, and O3+NO2 plots as well as spatial growth model outputs are included. Emissions and general air quality modeling are also discussed.
CASI
Air Quality; Atmospheric Models; Environment Models; Public Health; Air Pollution; Pollution Monitoring

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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*.

20070031784 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
The Hydrosphere State (HYDROS) Mission
Spence, Michael W.; Njoku, Eni; Kim, Yunjin; Entekhabi, Dara; Doiron, Terence; Piepmeier, Jeffrey; Girard, Ralph; September 28, 2004; 7 pp.; In English; Space 2004 Conference and Exhibit, 28-30 Spetember 2007, San Diego, CA, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2004-5956; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40208

The Hydrosphere State (HYDROS) Mission has been selected for the National Aeronautics and Space Administration (NASA) Earth System Science Pathfinder (ESSP) program. The objectives of HYDROS are to provide frequent, global measurements of surface soil moisture and surface freeze/thaw state. In order to adequately measure these geophysical parameters, a system capable of simultaneously measuring L-Band radiometer brightness temperatures at 40 km resolution and L-Band radar backscatter at 3 km resolution over a very wide swath is required. In addition, these science requirements must be satisfied under the stringent cost-cap imposed on all ESSP missions. As a solution to this challenging set of requirements, a relatively large, six meter, conically-scanning reflector antenna architecture was selected for the mission design. The HYDROS instrument will fly on a General Dynamics SA-200HP spacecraft bus. Although large deployable mesh antennas have been used in communication applications, this will mark the first time such technology is applied in a rotating configuration for high-resolution remote sensing.
Author
Earth Sciences; Soil Moisture; Brightness Temperature; Remote Sensing; NASA Programs; Earth Hydrosphere

20070031805 NASA Marshall Space Flight Center, Huntsville, AL, USA
Self-Consistent Model of Magnetospheric Ring Current and Propagating Electromagnetic Ion Cyclotron Waves: Waves in Multi-Ion Magnetosphere
Khazanov, G. V.; Gamayunov, K. V.; Gallagher, D. L.; Kozyra, J. U.; Journ. of Geophysical Research; October 05, 2006; 111, A10202; 23 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1029/2006JA011833

The further development of a self-consistent theoretical model of interacting ring current ions and electromagnetic ion cyclotron waves (Khazanov et al., 2003) is presented In order to adequately take into account wave propagation and refraction in a multi-ion magnetosphere, we explicitly include the ray tracing equations in our previous self-consistent model and use the general form of the wave kinetic equation. This is a major new feature of the present model and, to the best of our

knowledge, the ray tracing equations for the first time are explicitly employed on a global magnetospheric scale in order to self-consistently simulate the spatial, temporal, and spectral evolution of the ring current and of electromagnetic ion cyclotron waves To demonstrate the effects of EMIC wave propagation and refraction on the wave energy distribution and evolution, we simulate the May 1998 storm. The main findings of our simulation can be summarized as follows. First, owing to the density gradient at the plasmapause, the net wave refraction is suppressed, and He+-mode grows preferably at the plasmapause. This result is in total agreement with previous ray tracing studies and is very clearly found in presented B field spectrograms. Second, comparison of global wave distributions with the results from another ring current model (Kozyra et al., 1997) reveals that this new model provides more intense and more highly plasmapause-organized wave distributions during the May 1998 storm period Finally, it is found that He(+)-mode energy distributions are not Gaussian distributions and most important that wave energy can occupy not only the region of generation, i.e., the region of small wave normal angles, but all wave normal angles, including those to near 90 . The latter is extremely crucial for energy transfer to thermal plasmaspheric electrons by resonant Landau damping and subsequent downward heat transport and excitation of stable auroral red arcs.

Author

Ring Currents; Ion Cyclotron Radiation; Electromagnetic Radiation; Energy Transfer; Wave Propagation; Plasmapause

20070031919 NASA Marshall Space Flight Center, Huntsville, AL, USA

Observations of the Ion Signatures of Double Merging and the Formation of Newly Closed Field Lines

Chandler, Michael O.; Avanov, Levon A.; Craven, Paul D.; [2007]; 10 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Observations from the Polar spacecraft, taken during a period of northward interplanetary magnetic field (IMF) show magnetosheath ions within the magnetosphere with velocity distributions resulting from multiple merging sites along the same field line. The observations from the TIDE instrument show two separate ion energy-time dispersions that are attributed to two widely separated (-20Re) merging sites. Estimates of the initial merging times show that they occurred nearly simultaneously (within 5 minutes.) Along with these populations, cold, ionospheric ions were observed counterstreaming along the field lines. The presence of such ions is evidence that these field lines are connected to the ionosphere on both ends. These results are consistent with the hypothesis that double merging can produce closed field lines populated by solar wind plasma. While the merging sites cannot be unambiguously located, the observations and analyses favor one site poleward of the northern cusp and a second site at low latitudes.

Author

Ions; Plasma Interactions; Magnetosheath; Interplanetary Magnetic Fields; Signatures

20070031953 NASA Marshall Space Flight Center, Huntsville, AL, USA

TOPLA: A New Empirical Representation of the F-Region Topside and Plasmasphere for the International Reference Ionosphere

Bilitza, D.; Reinisch, B.; Gallagher, D.; Huang, X.; Truhlik, V.; Nsumei, P.; May 22, 2007; 1 pp.; In English; American Geophysical Union 2007 Joint Assembly, 22-25 May 2007, Acapulco, Mexico; Copyright; Avail.: Other Sources; Abstract Only

The goal of this LWS tools effort is the development of a new data-based F-region TOpside and PLAsmasphere (TOPLA) model for the electron density (Ne) and temperature (Te) for inclusion in the International Reference Ionosphere (IRI) model using newly available satellite data and models for these regions. The IRI model is the de facto international standard for specification of ionospheric parameters and is currently being considered as an ISO Technical Specification for the ionosphere. Our effort is directed towards improving the topside part of the model and extending it into the plasmasphere. Specifically we are planning to overcome the following shortcomings of the current IRI topside model: (I) overestimation of densities above 700 km by a factor of 2 and more, (3) unrealistically steep density profiles at high latitudes during very high solar activities, (4) no solar cycle variations and no semi-annual variations for the electron temperature, (5) discontinuities or unphysical gradients when merging with plasmaspheric models. We will report on first accomplishments and on the current status of the project.

Author

F Region; Plasmasphere; Atmospheric Physics; Earth Ionosphere

20070032060 NASA Marshall Space Flight Center, Huntsville, AL, USA

Impact of Ring Current Ions on Electromagnetic Ion Cyclotron Wave Dispersion Relation

Khazanov, G. V.; Gamayunov, K. V.; [2007]; 48 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): UPN-370-16-10; UPN 370-16-10; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032060

Effect of the ring current ions in the real part of electromagnetic ion Cyclotron wave dispersion relation is studied on global scale. Recent Cluster observations by Engebretson et al. showed that although the temperature anisotropy of is energetic (> 10 keV) ring current protons was high during the entire 22 November 2003 perigee pass, electromagnetic ion cyclotron waves were observed only in conjunction with intensification of the ion fluxes below 1 keV by over an order of magnitude. To study the effect of the ring current ions on the wave dispersive properties and the corresponding global wave redistribution, we use a self-consistent model of interacting ring current and electromagnetic ion cyclotron waves, and simulate the May 1998 storm. The main findings of our simulation can be summarized as follows: First, the plasma density enhancement in the night MLT sector during the main and recovery storm phases is mostly caused by injection of suprathermal plasma sheet H + (approximately < 1 keV), which dominate the thermal plasma density. Second, during the recovery storm phases, the ring current modification of the wave dispersion relation leads to a qualitative change of the wave patterns in the postmidnight-dawn sector for L > 4.75. This 'new' wave activity is well organized by outward edges of dense suprathermal ring current spots, and the waves are not observed if the ring current ions are not included in the real part of dispersion relation. Third, the most intense wave-induced ring current precipitation is located in the night MLT sector and caused by modification of the wave dispersion relation. The strongest precipitating fluxes of about 8 X 10(exp 6)/ (cm(exp 2) - s X st) are found near L=5.75, MLT=2 during the early recovery phase on 4 May. Finally, the nightside precipitation is more intense than the dayside fluxes, even if there are less intense waves, because the convection field moves ring current ions into the loss cone on the nightside, but drives them out of the loss cone on the dayside. So convection and wave scattering reinforce each other in the nightside, but interfere in the dayside sector.

Author

Ion Cyclotron Radiation; Ring Currents; Wave Dispersion; Atmospheric Electricity; Earth Magnetosphere; Plasma Currents; Ionospheric Currents

20070032068 NASA Marshall Space Flight Center, Huntsville, AL, USA

Analysis of The Surface Radiative Budget Using ATLAS Data for San Juan, Puerto Rico

Luvall, Jeffrey C.; Rickman, D. L.; Gonzalez, J.; Comarazamy, Daniel; Picon, Ana; June 25, 2007; 4 pp.; In English; 32nd International Symposium on Remote Sensing (ISRSE), 25-29 Jun. 2007, San Jose, Costa Rica; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

The additional beating of the air over the city is the result of the replacement of naturally vegetated surfaces with those composed of asphalt, concrete, rooftops and other man-made materials. The temperatures of these artificial surfaces can be 20 to 40 C higher than vegetated surfaces. This produces a dome of elevated air temperatures 5 to 8 C greater over the city, compared to the air temperatures over adjacent rural areas. Urban landscapes are a complex mixture of vegetated and nonvegetated surfaces. It is difficult to take enough temperature measurements over a large city area to characterize the complexity of urban radiant surface temperature variability. The NASA Airborne Thermal and Land Applications Sensor (ATLAS) operates in the visual and IR bands was used in February 2004 to collect data from San Juan, Puerto Rico with the main objective of investigating the Urban Heat Island (UHI) in tropical cities.

Author

Surface Temperature; Heat Islands; Cities; Airborne Equipment; Sensors; Topography; Puerto Rico; Data Processing

20070032073 NASA Goddard Space Flight Center, Greenbelt, MD, USA

New SPDF Directions and Evolving Services Supporting Heliophysics Research

McGuire, Robert E.; Candey, Robert M.; Bilitza, D.; Chimiak, Reine A.; Cooper, John F.; Fung, Shing F.; Han, David B.; Harris, Bernie; Johnson R.; Klipsch, C.; Leckner, H.; Liu, M.; Kovalick, T.; Roberts, Aaron; [2006]; 1 pp.; In English; 2006 AGU Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The next advances in Heliophysics science and its paradigm of a Great Observatory require an increasingly integrated and transparent data environment, where data can be easily accessed and used across the boundaries of both missions and traditional disciplines. The Space Physics Data Facility (SPDF) project includes uniquely important multi-mission data services with current data from most operating space physics missions. This paper reviews the capabilities of key services now available and the directions in which they are expected to evolve to enable future multi-mission correlative research. The Coordinated Data Analysis Web (CDAWeb) and Satellite Situation Center Web (SSCWeb), critically supported by the

Common Data Format (CDF) effort and supplemented by more focused science services such as OMNIWeb and technical services such as data format translations are important operational capabilities serving the international community today (and cited last year by 20% of the papers published in JGR Space Physics). These services continue to add data from most current missions as SPDF works with new missions such as THEMIS to help enable their unique science goals and the meaningful sharing of their data in a multi-mission correlative context. Recent enhancements to CDF, our 3D Java interactive orbit viewer (TIPSOD), the CDAWeb Plus system, increasing automation of data service population, the new folding of the VSPO effort into SPDF and our continuing thrust towards fully-functional web services APIs to allow ready invocation from distributed external middleware and clients will be shown.
Author
Geophysics; Heliosphere; Research; Atmospheric Physics

20070032661 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Erosion Rates at the Mars Exploration Rover Landing Sites and Long-Term Climate Change on Mars
Golombek, M. P.; Grant, J. A.; Crumpler, L. S.; Greeley, R.; Arvidson, R. E.; Bell, J. F., III; Weitz, C. M.; Sullivan, R.; Christensen, P. R.; Soderblom, L. A.; Squyres, S. W.; Journal Of Geophysical Research; December 8, 2006; ISSN 0148-0227; Volume 111; 14 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40227; http://dx.doi.org/10.1029/2006JE002754

Erosion rates derived from the Gusev cratered plains and the erosion of weak sulfates by saltating sand at Meridiani Planum are so slow that they argue that the present dry and desiccating environment has persisted since the Early Hesperian. In contrast, sedimentary rocks at Meridiani formed in the presence of groundwater and occasional surface water, and many Columbia Hills rocks at Gusev underwent aqueous alteration during the Late Noachian, approximately coeval with a wide variety of geomorphic indicators that indicate a wetter and likely warmer environment. Two-toned rocks, elevated ventifacts, and perched and undercut rocks indicate localized deflation of the Gusev plains and deposition of an equivalent amount of sediment into craters to form hollows, suggesting average erosion rates of approx.0.03 nm/yr. Erosion of Hesperian craters, modification of Late Amazonian craters, and the concentration of hematite concretions in the soils of Meridiani yield slightly higher average erosion rates of 1-10 nm/yr in the Amazonian. These erosion rates are 2-5 orders of magnitude lower than the slowest continental denudation rates on Earth, indicating that liquid water was not an active erosional agent. Erosion rates for Meridiani just before deposition of the sulfate-rich sediments and other eroded Noachian areas are comparable with slow denudation rates on Earth that are dominated by liquid water. Available data suggest the climate change at the landing sites from wet and likely warm to dry and desiccating occurred sometime between the Late Noachian and the beginning of the Late Hesperian (3.7-3.5 Ga).
Author
Erosion; Mars Exploration; Climate Change; Mars Surface; Roving Vehicles; Sediment Transport; Planetary Geology; Geomorphology

20070032664 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Internal Structure of Rhea
Castillo-Rogez, Julie; Journal of Geophysical Research; November 17, 2006; Volume 111; 13 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40230; http://dx.doi.org/10.1029/2004JE002379

We model the interior of Rhea on the basis of observational constraints and the results from geodynamical models available in the literature. Ten main types of models are defined, depending on the presence or absence of a high-pressure ice layer (ice II), and the extent of separation of the rock component from the volatiles. The degree-two gravity coefficients are computed for each of these models in order to assess which properties of the interior are likely to be inferred from Cassini radio science measurements scheduled on 26 November 2005. C22 greater than 2.5 x 10(exp -4) indicates that the satellite is undifferentiated, except for a slight increase in density with depth resulting from material self-compression. C22 between 1.67 x 10(exp -4)(lower bound) and 1.90 x 10(exp -4) indicates the presence of a rocky core, whose radius can be determined from the satellite's mass and ices densities, for a given temperature profile. For other values, most of the ten models cannot be distinguished from each other. However, assumptions on the density of the rock phase, presence or absence of ice II, and the degree of differentiation could allow a unique model to be determined in many cases. While the calculation presented in this work assumes that Rhea is in hydrostatic equilibrium, it is likely that Rhea' gravity field is partly affected by nonhydrostatic anomalies.
Author
Rhea (Astronomy); Hydrostatics; Coefficients; Temperature Profiles

20070032666 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Radar Probing of Planetary Regoliths: An Example from the Northern Rim of Imbrium Basin

Thompson, Thomas W.; Campbell, Bruce A.; Ghent, Rebecca R.; Hawke, B. Ray; Leverington, David W.; Journal of Geophysical Research; June 30, 2006; ISSN 0148-0227; Volume 111; 10 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40232; http://dx.doi.org/10.1029/2005JE002566

Imaging radar measurements at long wavelengths (e.g., >30 cm) allow deep (up to tens of meters) probing of the physical structure and dielectric properties of planetary regoliths. We illustrate a potential application for a Mars orbital synthetic aperture radar (SAR) using new Earth-based 70-cm wavelength radar data for the Moon. The terrae on the northern margin of Mare Imbrium, the Montes Jura region, have diffuse radar backscatter echoes that are 2-4 times weaker at 3.8-cm, 70-cm, and 7.5-m wavelengths than most other lunar nearside terrae. Possible geologic explanations are (1) a pyroclastic deposit associated with sinuous rilles in this region, (2) buried mare basalt or a zone of mixed highland/basaltic debris (cryptomaria), or (3) layers of ejecta associated with the Iridum and Plato impacts that have fewer meter-sized rocks than typical highlands regolith. While radar data at 3.8-cm to 7.5-m wavelengths suggest significant differences between the Montes Jura region and typical highlands, the surface geochemistry and rock abundance inferred from Clementine UV-VIS data and eclipse thermal images are consistent with other lunar terrae. There is no evidence for enhanced iron abundance, expected for basaltic pyroclastic deposits, near the source vents of the sinuous rilles radial to Plato. The regions of low 70-cm radar return are consistent with overlapping concentric ''haloes'' about Iridum and Plato and do not occur referentially in topographically low areas, as is observed for radar-mapped cryptomaria. Thus we suggest that the extensive radar-dark area associated with the Montes Jura region is due to overlapping, rock-poor ejecta deposits from Iridum and Plato craters. Comparison of the radial extent of low-radar-return crater haloes with a model for ejecta thickness shows that these rock-poor layers are detected by 70-cm radar where they are on the order of 10 m and thicker. A SAR in orbit about Mars could use similar deep probing to reveal the nature of crater - and basin-related deposits.

Author

Synthetic Aperture Radar; Imaging Radar; Radar Measurement; Dielectric Properties; Lunar Topography; Backscattering; Radar Echoes; Regolith

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METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20070031877 NASA Marshall Space Flight Center, Huntsville, AL, USA

The ENSO Effect on the Temporal and Spatial Distribution of Global Lightning Activity

Chronis, Themis G.; Goodman, Steven J.; Cecil, Dan; Buechler, Dennis; Pittman, Jasna; Robertson, Franklin R.; Blakeslee, Richard J.; [2007]; 17 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

The recently reprocessed (1997-2006) OTD/LIS database is used to investigate the global lightning climatology in response to the ENSO cycle. A linear correlation map between lightning anomalies and ENSO (NINO3.4) identifies areas that generally follow patterns similar to precipitation anomalies. We also observed areas where significant lightning/ENSO correlations are found and are not accompanied of significant precipitation/ENSO correlations. An extreme case of the strong decoupling between lightning and precipitation is observed over the Indonesian peninsula (Sumatra) where positive lightning/NINO3.4 correlations are collocated with negative precipitation/NINO3.4 correlations. Evidence of linear relationships between the spatial extent of thunderstorm distribution and the respective NINO3.4 magnitude are presented for different regions on the Earth. Strong coupling is found over areas remote to the main ENSO axis of influence and both during warm and cold ENSO phases. Most of the resulted relationships agree with the tendencies of precipitation related to ENSO empirical maps or documented teleconnection patterns. Over the Australian continent, opposite behavior in terms of thunderstorm activity is noted for warm ENSO phases with NINO3.4 magnitudes with NINO3.4>+l.08 and 0<NqNO3.4<I.08. Finally, we investigate the spatial distribution of areas that consistently portrayed enhanced lightning activity during the main warm/cold (El Nino/La Nina) ENSO episodes of the past decade. The observed patterns show no spatial overlapping and identify areas that in their majority are in agreement with empirical precipitation/ENSO maps. The areas that appear during the warm ENSO phase are found over regions that have been identified as anomalous Hadley circulation ENSO-related patterns. The areas that appear during the cold ENSO phase are found predominantly around the west hemisphere equatorial belt and are in their majority identified by anomalous Walker circulation.

Author

Climatology; Lightning; Thunderstorms; Teleconnections (Meteorology); El Nino; Southern Oscillation; Correlation

20070031882 NASA Marshall Space Flight Center, Huntsville, AL, USA; Alabama Univ., Huntsville, AL, USA
DIAL Measurements of Free-Tropospheric Ozone Profiles in Huntsville, AL
Kuang, Shi; Burris, John; Newchurch, Michael J.; Johnson, Steve; [2007]; 36 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

A tropospheric ozone Differential Absorption Lidar (DIAL) system, developed jointly by NASA and the University of Alabama at Huntsville (UAH), measures free-tropospheric ozone profiles between 4-10 km. Located at 192 meters altitude in the Regional Atmospheric Profiling Laboratory for Discovery (RAPCD) on the UAH campus in Huntsville, AL, USA, this tropospheric ozone lidar operates under both daytime and nighttime conditions. Frequent coincident ozonesonde flights and theoretical calculations provide evidence to indicate the retrieval accuracy ranges from better than 8% at 4km to 40%-60% at 10 kin with 750-m vertical resolution and 30-minute integration. With anticipated improvements to allow retrievals at both higher and lower altitudes, this ozone lidar, along with co-located aerosol and Doppler Wind Lidars, will provide a unique 18 dataset for investigations of PBL and free-tropospheric chemical and dynamic processes.
Author
Ozone; Chemical Reactions; Differential Absorption Lidar; Troposphere; Aerosols; Optical Radar

20070031943 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Clouds in GEOS-5
Bacmeister, Julio; Rienecker, Michele; Suarez, Max; Norris, Peter; May 22, 2007; 1 pp.; In English; American Geophysical Union 2007 Joint Assembly, 22-25 May 2007, Acapulco, Mexico; No Copyright; Avail.: Other Sources; Abstract Only

The GEOS-5 atmospheric model is being developed as a weather-and-climate capable model. It must perform well in assimilation mode as well as in weather and climate simulations and forecasts and in coupled chemistry-climate simulations. In developing GEOS-5, attention has focused on the representation of moist processes. The moist physics package uses a single phase prognostic condensate and a prognostic cloud fraction. Two separate cloud types are distinguished by their source: 'anvil' cloud originates in detraining convection, and large-scale cloud originates in a PDF-based condensation calculation. Ice and liquid phases for each cloud type are considered. Once created, condensate and fraction from the anvil and statistical cloud types experience the same loss processes: evaporation of condensate and fraction, auto-conversion of liquid or mixed phase condensate, sedimentation of frozen condensate, and accretion of condensate by falling precipitation. The convective parameterization scheme is the Relaxed Arakawa-Schubert, or RAS, scheme. Satellite data are used to evaluate the performance of the moist physics packages and help in their tuning. In addition, analysis of and comparisons to cloud-resolving models such as the Goddard Cumulus Ensemble model are used to help improve the PDFs used in the moist physics. The presentation will show some of our evaluations including precipitation diagnostics.
Author
Climate Models; GEOS Satellites (ESA); Weather; Anvil Clouds; Convection Clouds

20070031972 NASA Marshall Space Flight Center, Huntsville, AL, USA
Electrification in Hurricanes over the Tropical Americas: Implication for Stratospheric Water Vapor
Pittman, Jasna V.; Chronis, Themis G.; Robertson, Franklin R.; Miller, Timothy L.; May 27, 2007; 1 pp.; In English; 1st International Summit on Hurricanes and Climate Change/Aegean Conferences, 27 May - 1 Jun. 2007, Crete, Greece; No Copyright; Avail.: Other Sources; Abstract Only

This study explores the relation between lightning activity and water vapor in the Tropical Tropopause Layer (TTL) over hurricane systems in the Tropical Americas. The hypothesis herein is that hurricanes that exhibit enhanced lightning activity are associated with stronger updrafts that can transport more moisture directly into the TTL (and subsequently into the tropical stratosphere) or even directly into the tropical stratosphere over this region. The TTL over the Tropical Americas, which includes the Caribbean and Gulf of Mexico, is of particular interest, because summertime cold point tropopause is the lowest in height and thus the warmest in temperature over the tropics. The latter condition implies higher saturation values and thus potential for more water vapor to enter the stratosphere. Climate forecast is very sensitive to stratospheric water vapor abundance, because of the key role that water vapor plays in regulating the chemical and radiative properties of the stratosphere. Given the potential for increases in hurricane intensity and frequency under predicted warmer conditions, it becomes essential to understand the effect of hurricanes on stratospheric water vapor. In this study, we use a combination of ground and space-borne observations as well as trajectory calculations. The observations include: cloud-to-ground (CG) lightning data from the U.S. National Lightning Detection Network (NLDN), geostationary infrared observations from the National Climatic Data Center Hurricane Satellite (HURSAT) data set, cloud properties from Aqua-MODIS, and water vapor from Aura-MLS. We analyze hurricanes from the 2005 season when Aura-MLS data are available, namely: Dennis, Emily, Katrina, Rita, and Wilma. Our analysis consists of examining CG lightning, cloud-top properties, and TTL water vapor (i.e.,

100 and 147 mb) over the hurricane while it remains over water in the Tropical Americas region. We investigate daily as well as diurnal statistical properties. The hurricanes analyzed in this study showed that lightning activity is negatively correlated with minimum infrared brightness temperature and positively correlated with 100-mb water vapor. An examination of the maxima in water vapor observed over the hurricane not only shows larger magnitudes, but also larger differences between water vapor averages and water vapor maxima over the hurricane as lightning activity increases. Trajectory calculations are performed using the Flextra model in order to investigate the fate of the moister air masses found in the TTL.
Author
Lightning; Water Vapor; Tropical Regions; Hurricanes; Moisture; Climatology; Cloud Physics

20070031978 NASA Marshall Space Flight Center, Huntsville, AL, USA
Uncertainty in Tropical Ocean Latent Heat Flux Variability During the Last 25 Years
Robertson, F. R.; Lu, H.-I.; Bosilovich, M. G.; Miller, T. L.; [2007]; 14 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

When averaged over the tropical oceans (30deg N/S), latent heat flux anomalies derived from passive microwave satellite measurements as well as reanalyses and climate models driven with specified seal-surface temperatures show considerable disagreement in their decadal trends. These estimates range from virtually no trend to values over 8.4 W/sq m decade. Satellite estimates also tend to have a larger interannual signal related to El Nino/Southern Oscillation (ENSO) events than do reanalyses or model simulations. An analysis of wind speed and humidity going into bulk aerodynamic calculations used to derive these fluxes reveals several error sources. Among these are apparent remaining intercalibration issues affecting passive microwave satellite 10 m wind speeds and systematic biases in retrieval of near-surface humidity. Likewise, reanalyses suffer from discontinuities in availability of assimilated data that affect near surface meteorological variables. The results strongly suggest that current latent heat flux trends are overestimated.
Author
Latent Heat; Satellite Observation; Meteorological Parameters; Climate Models; Tropical Regions; Heat Flux; Surface Temperature

20070032659 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Improvements in the Scalability of the NASA Goddard Multiscale Modeling Framework for Hurricane Climate Studies
Shen, Bo-Wen; Tao, Wei-Kuo; Chern, Jiun-Dar; March 2007; 30 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Improving our understanding of hurricane inter-annual variability and the impact of climate change (e.g., doubling CO2 and/or global warming) on hurricanes brings both scientific and computational challenges to researchers. As hurricane dynamics involves multiscale interactions among synoptic-scale flows, mesoscale vortices, and small-scale cloud motions, an ideal numerical model suitable for hurricane studies should demonstrate its capabilities in simulating these interactions. The newly-developed multiscale modeling framework (MMF, Tao et al., 2007) and the substantial computing power by the NASA Columbia supercomputer show promise in pursuing the related studies, as the MMF inherits the advantages of two NASA state-of-the-art modeling components: the GEOS4/fvGCM and 2D GCEs. This article focuses on the computational issues and proposes a revised methodology to improve the MMF's performance and scalability. It is shown that this prototype implementation enables 12-fold performance improvements with 364 CPUs, thereby making it more feasible to study hurricane climate.
Author
Carbon Dioxide; Global Warming; Climate Change; Hurricanes; Mesoscale Phenomena

20070032662 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Nadir Measurements of Carbon Monoxide Distributions by the Tropospheric Emission Spectrometer Instrument Onboard the Aura Spacecraft: Overview of Analysis Approach and Examples of Initial Results
Rinsland, Curtis P.; Luo, Ming; Logan, Jennifer A.; Beer, Reinhard; Worden, Helen; Kulawik, Susan S.; Rider, David; Osterman, Greg; Gunson, Michael; Eldering, Annmarie; Goldman, Aaron; Shephard, Mark; Clough, Shepard A.; Rodgers, Clive; Lampel, Michael; Chiou, Linda; Geophysical Research Letters; November 22, 2006; ISSN 0094-8276; Volume 33; 6 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40228; http://dx.doi.org/10.1029/2006GL027000

We provide an overview of the nadir measurements of carbon monoxide (CO) obtained thus far by the Tropospheric

Emission Spectrometer (TES). The instrument is a high resolution array Fourier transform spectrometer designed to measure infrared spectral radiances from low Earth orbit. It is one of four instruments successfully launched onboard the Aura platform into a sun synchronous orbit at an altitude of 705 km on July 15, 2004 from Vandenberg Air Force Base, California. Nadir spectra are recorded at 0.06/cm spectral resolution with a nadir footprint of 5 x 8 km. We describe the TES retrieval approach for the analysis of the nadir measurements, report averaging kernels for typical tropical and polar ocean locations, characterize random and systematic errors for those locations, and describe instrument performance changes in the CO spectral region as a function of time. Sample maps of retrieved CO for the middle and upper troposphere from global surveys during December 2005 and April 2006 highlight the potential of the results for measurement and tracking of global pollution and determining air quality from space.
Author
Troposphere; Air Quality; Carbon Monoxide; Global Air Pollution; Spectral Resolution; Low Earth Orbits

20070032665 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Is Solar Variability Reflected in the Nile River?
Ruzmaikin, Alexander; Feynman, Joan; Yung, Yuk L.; Journal of Geophysical Research; November 11, 2006; ISSN 0148-0227; Volume 111; 8 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNG04GN02G; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40231; http://dx.doi.org/10.1029/2006JD007462

We investigate the possibility that solar variability influences North African climate by using annual records of the water level of the Nile collected in 622-1470 A.D. The time series of these records are nonstationary, in that the amplitudes and frequencies of the quasi-periodic variations are time-dependent. We apply the Empirical Mode Decomposition technique especially designed to deal with such time series. We identify two characteristic timescales in the records that may be linked to solar variability: a period of about 88 years and one exceeding 200 years. We show that these timescales are present in the number of auroras reported per decade in the Northern Hemisphere at the same time. The 11-year cycle is seen in the Nile's high-water level variations, but it is damped in the low-water anomalies. We suggest a possible physical link between solar variability and the low-frequency variations of the Nile water level. This link involves the influence of solar variability on the atmospheric Northern Annual Mode and on its North Atlantic Ocean and Indian Ocean patterns that affect the rainfall over the sources of the Nile in eastern equatorial Africa.
Author
Solar Activity; Periodic Variations; Climate; Time Series Analysis; Decomposition; Auroras

20070032668 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Relationships of Upper Tropospheric Water Vapor, Clouds and SST: MLS Observations, ECMWF Analyses and GCM Simulations
Su, Hui; Waliser, Duane E.; Jiang, Jonathan H.; Li, Jui-lin; Read, William G.; Waters, Joe W.; Tompkins, Adrian M.; Geophysical Research Letters; November 18, 2006; ISSN 0094-8276; Volume 33; 5 pp.; In English; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40234; http://dx.doi.org/10.1029/2006GL027582

The relationships of upper tropospheric water vapor (UTWV), cloud ice and sea surface temperature (SST) are examined in the annual cycles of ECMWF analyses and simulations from 15 atmosphere-ocean coupled models which were contributed to the IPCC AR4. The results are compared with the observed relationships based on UTWV and cloud ice measurements from MLS on Aura. It is shown that the ECMWF analyses produce positive correlations between UTWV, cloud ice and SST, similar to the MLS data. The rate of the increase of cloud ice and UTWV with SST is about 30% larger than that for MLS. For the IPCC simulations, the relationships between UTWV, cloud ice and SST are qualitatively captured. However, the magnitudes of the simulated cloud ice show a considerable disagreement between models, by nearly a factor of 10. The amplitudes of the approximate linear relations between UTWV, cloud ice and SST vary by a factor up to 4.
Author
Troposphere; Water Vapor; Sea Surface Temperature; Atmospheric Models; Climate Change; Ocean Models; Weather Forecasting

20070032670 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

A Conceptual Titan Orbiter Mission Using Advanced Radioisotope Power Systems

Abelson, Robert D.; Shirley, James H.; Spilker, Thomas R.; February 12, 2006; 8 pp.; In English; Space Technology and Applications International Forum, STAIF-2006, 12-16 Feb. 2006, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40215

This study details a conceptual follow-on Titan orbiter mission that would provide full global topographic coverage. surface imaging, and meteorological characterization of the atmosphere over a nominal 5-year science mission duration. The baseline power requirement is approx.1 kWe at EOM and is driven by a high power radar instrument that would provide 3-dimensional measurements of atmospheric clouds, precipitation, and surface topography. While this power level is moderately higher than that of the Cassini spacecraft. higher efficiency advanced RPSs could potentially reduce the plutonium usage to less than 1/3rd of that used on the Cassini spacecraft. The Titan Orbiter mission is assumed to launch in 2015. It would utilize advanced RPSs to provide all on-board power.

Author

Precipitation (Meteorology); Topography; Cassini Mission; Precipitation Measurement; Imaging Techniques

20070032681 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Evolution of the Stratopause During the 2006 Major Warming: Satellite Data and Assimilated Meteorological Analyses

Manney, Gloria L.; Krueger, Kirstin; Pawson, Steven; Schwartz, Michael J.; Daffer, William H.; Livesey, Nathaniel J.; Remsberg, Ellis E.; Mlynczak, Martin G.; Russell, James M., III; Waters, Joe W.; [2007]; 7 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Microwave Limb Sounder and Sounding of the Atmosphere with Broadband Emission Radiometry data show the polar stratopause, usually higher than and separated from that at midlatitudes, dropping from <55-60 to near 30 km, and cooling dramatically in January 2006 during a major stratospheric sudden warming (SSW). After a nearly isothermal period, a cool stratopause reforms near 75 km in early February, then drops to <55 km and warms. The stratopause is separated in longitude as well as latitude, with lowest temperatures in the transition regions between higher and lower stratopauses. Operational assimilated meteorological analyses, which are not constrained by data at stratopause altitude, do not capture a secondary temperature maximum that overlies the stratopause or the very high stratopause that reforms after the SSW; they underestimate the stratopause altitude variation during the SSW. High-quality daily satellite temperature measurements are invaluable in improving our understanding of stratopause evolution and its representation in models and assimilation systems.

Author

Stratospheric Warming; Atmospheric Temperature; Microwave Sounding; Satellite Sounding; Temperate Regions; Stratopause

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*.

20070032667 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Estimation of Interbasin Transport Using Ocean Bottom Pressure: Theory and Model for Asian Marginal Seas

Song, Y. Tony; Journal of Geophysical Research; November 3, 2006; Volume 111; 11 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): N00014-03-IP-20059; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40233; http://dx.doi.org/10.1029/2005JC003189

The Asian Marginal Seas are interconnected by a number of narrow straits, such as the Makassar Strait connecting the Pacific Ocean with the Indian Ocean, the Luzon Strait connecting the South China Sea with the Pacific Ocean, and the Korea/Tsushima Strait connecting the East China Sea with the Japan/East Sea. Here we propose a method, the combination of the 'geostrophic control' formula of Garrett and Toulany (1982) and the 'hydraulic control' theory of Whitehead et al. (1974), allowing the use of satellite-observed sea-surface-height (SSH) and ocean-bottom-pressure (OBP) data for estimating interbasin transport. The new method also allows separating the interbasin transport into surface and bottom fluxes that play

an important role in maintaining the mass balance of the regional oceans. Comparison with model results demonstrates that the combined method can estimate the seasonal variability of the strait transports and is significantly better than the method of using SSH or OBP alone.
Author
Mass Distribution; Annual Variations; Straits; Ocean Bottom; 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*.

20070031944 NASA Johnson Space Center, Houston, TX, USA; Colorado Univ., Boulder, CO, USA
Subclinical Shed of Infectious Varicella zoster Virus in Astronauts
Cohrs, Randall J.; Mehta, Satish K.; Schmid, D. Scott; Gilden, Donald H.; Pierson, Duane L.; [2007]; 4 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

Aerosol borne varicella zoster virus (VZV) enters the nasopharynx and replicates in tonsillar T-cells, resulting in viremia and varicella (chickenpox). Virus then becomes latent in cranial nerve, dorsal root and autonomic nervous system ganglia along the entire neuraxis (1). Decades later, as cell-mediated immunity to VZV declines (4), latent VZV can reactivate to produce zoster (shingles). Infectious VZV is present in patients with varicella or zoster, but shed of infectious virus in the absence of disease has not been shown. We previously detected VZV DNA in saliva of astronauts during and shortly after spaceflight, suggesting stress induced subclinical virus reactivation (3). We show here that VZV DNA as well as infectious virus in present in astronaut saliva. VZV DNA was detected in saliva during and after a 13-day spaceflight in 2 of 3 astronauts (Fig. panel A). Ten days before liftoff, there was a rise in serum anti-VZV antibody in subjects 1 and 2, consistent with virus reactivation. In subject 3, VZV DNA was not detected in saliva, and there was no rise in anti-VZV antibody titer. Subject 3 may have been protected from virus reactivation by having zoster <10 years ago, which provides a boost in cell-medicated immunity to VZV (2). No VZV DNA was detected in astronaut saliva months before spaceflight, or in saliva of 10 age/sex-matched healthy control subjects sampled on alternate days for 3 weeks (88 saliva samples). Saliva taken 2-6 days after landing from all 3 subjects was cultured on human fetal lung cells (Fig. panel B). Infectious VZV was recovered from saliva of subjects 1 and 2 on the second day after landing. Virus specificity was confirmed by antibody staining and DNA analysis which showed it to be VZV of European descent, common in the US (5). Further, both antibody staining and DNA PCR demonstrated that no HSV-1 was detected in any infected culture. This is the first report of infectious VZV shedding in the absence of clinical disease. Spaceflight presents a uniquely stressful environment which includes physical isolation and confinement, anxiety, sleep deprivation, as well as exposure to increased radiation and microgravity. It is interesting that in our study, VZV and not HSV-1 reactivation was detected, since stress-induced HSV-1 reactivation has been reported (6). Future studies are needed to determine the specific inducer of VZV reactivation.
Author
Astronauts; Viral Diseases; Viruses; Saliva; Clinical Medicine; Infectious Diseases

20070032009 Civil Aerospace Medical Inst., Oklahoma City, OK, USA; State Highway Patrol, Columbus, OH, USA
Postmortem Ethanol Testing Procedures Available to Accident Investigators
Canfield, Dennis V.; Brink, James D.; Johnson, Robert D.; Lewis, Russell J.; Dubowski, Kurt M.; August 2007; 9 pp.; In English
Contract(s)/Grant(s): AM-B-06-TOX-204
Report No.(s): DOT/FAA/AM-07/22; No Copyright; Avail.: CASI: A02, Hardcopy

An ethanol positive fatal case reported as being from ingestion was ultimately determined to be from postmortem ethanol production using the ratio of two serotonin metabolites found in urine. This case involved a transportation accident that could have resulted in additional hardships for the victim's family through loss of compensation and reputation.
Author
Ethyl Alcohol; Serotonin; Toxicology; Toxic Hazards; Activity (Biology)

20070032645 NASA Marshall Space Flight Center, Huntsville, AL, USA

Anaerovirgula multivorans gen. nov., sp. nov., a Novel Spore-Forming, Alkaliphilic Anaerobe Isolated from Owens Lake, California, USA

Pikuta, Elena V.; Itoh, Takashi; Krader, Paul; Whitman, William B.; Hoover, Richard B.; International Journal of Systematic and Evolutionary Microbiology; November 2006; Volume 56, pp. 2623-2629; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1099/ijs.0.64198-0

A novel, alkaliphilic, obligately anaerobic bacterium, strain SCAT, was isolated from mud sediments of a soda lake in California, USA. The rod-shaped cells were motile, Gram-positive, formed spores and were 0.4-0.5x2.5-5.0 micrometers in size. Growth occurred within the pH range 6.7-10.0 and was optimal at pH 8.5. The temperature range for growth was 10-45 degrees C, with optimal growth at 35 degrees C. NaCl was required for growth. Growth occurred at 0.5-9.0% (w/v) NaCl and was optimal at 1-2% (w/v). The novel isolate was a catalase-negative chemo-organoheterotroph that fermented sugars, proteolysis products, some organic and amino acids, glycerol, d-cellobiose and cellulose. It was also capable of growth by the Stickland reaction. Strain SCAT was sensitive to tetracycline, chloramphenicol, rifampicin and gentamicin, but it was resistant to ampicillin and kanamycin. The G+C content of the genomic DNA was 34.2 mol%. Major fatty acid components were C14:0, iso-C15:0, C16:1omega9c and C16:0. 16S rRNA gene sequence analysis of strain SCAT showed a similarity of approximately 97% with the type strains of Clostridium formicaceticum and Clostridium aceticum in clostridial cluster XI and a similarity of less than 94.2% to any other recognized Clostridium species and those of related genera in this cluster. Strain SCAT was clearly differentiated from C. formicaceticum and C. aceticum based on comparison of their phenotypic properties and fatty acid profiles, as well as low levels of DNA-DNA relatedness between strain SCAT and the type strains of these two species. Therefore, strain SCAT is considered to represent a novel species of a new genus, Anaerovirgula multivorans gen. nov., sp. nov., in clostridial cluster XI. The type strain is SCAT (=ATCC BAA-1084T=JCM 12857T=DSM 17722T=CIP 107910T).

Author

Anaerobes; Bacteria; Sediments; Lakes; Spores; Clostridium

52
AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments, see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

20070031831 NASA Johnson Space Center, Houston, TX, USA

Development of Sub-optimal Airway Protocols for the International Space Station (ISS) by the Medical Operation Support Team (MOST)

Polk, James D.; Parazynski, Scott; Kelly, Scott; Hurst, Victor, IV; Doerr, Harold K.; May 13, 2007; 14 pp.; In English; ASMA 78th Aerospace Medical Association Annual Conference, 13-17 May 2007, New Orleans, LA, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS9-02078; Copyright; Avail.: CASI: A03, Hardcopy

Airway management techniques are necessary to establish and maintain a patent airway while treating a patient undergoing respiratory distress. There are situations where such settings are suboptimal, thus causing the caregiver to adapt to these suboptimal conditions. Such occurrences are no exception aboard the International Space Station (ISS). As a result, the NASA flight surgeon (FS) and NASA astronaut cohorts must be ready to adapt their optimal airway management techniques for suboptimal situations. Based on previous work conducted by the Medical Operation Support Team (MOST) and other investigators, the MOST had members of both the FS and astronaut cohorts evaluate two oral airway insertion techniques for the Intubating Laryngeal Mask Airway (ILMA) to determine whether either technique is sufficient to perform in suboptimal conditions within a microgravity environment. Methods All experiments were conducted in a simulated microgravity environment provided by parabolic flight aboard DC-9 aircraft. Each participant acted as a caregiver and was directed to attempt both suboptimal ILMA insertion techniques following a preflight instruction session on the day of the flight and a demonstration of the technique by an anesthesiologist physician in the simulated microgravity environment aboard the aircraft. Results Fourteen participants conducted 46 trials of the suboptimal ILMA insertion techniques. Overall, 43 of 46 trials (94%) conducted were properly performed based on criteria developed by the MOST and other investigators. Discussion The study demonstrated the use of airway management techniques in suboptimal conditions relating to space flight. Use of these

techniques will provide a crew with options for using the ILMA to manage airway issues aboard the ISS. Although it is understood that the optimal method for patient care during space flight is to have both patient and caregiver restrained, these techniques provide a needed backup should conditions not present themselves in an ideal manner.
Author
International Space Station; Respiration; Resuscitation; Respirators; Breathing Apparatus; Emergency Breathing Techniques; Education

20070031928 NASA Johnson Space Center, Houston, TX, USA
Validation of the Pulmonary Function System for Use on the International Space Station
McCleary, Frank A.; Moore, Alan D., Jr.; Hagan, R. Donald; September 2007; 22 pp.; In English
Report No.(s): NASA/TP-2007-214756; S-1006; Copyright; Avail.: CASI: A03, Hardcopy

Aerobic deconditioning occurs during long-duration spaceflight despite the use of exercise countermeasures. As a part of International Space Station (ISS) medical operations, periodic tests designed to estimate aerobic capacity are performed prior to, during, and after missions of greater than 30 days in duration. These tests track changes in aerobic fitness and determine the effectiveness of exercise countermeasures. The purpose of this investigation was to compare exercise metabolic gas analysis measurements (including oxygen consumption) obtained by the Pulmonary Function System (PFS) to those collected using a reference metabolic gas analysis system: the ParvoMedics TrueOne 2400 system (ParvoMedics, Salt Lake City, UT). This system has been extensively validated and is currently utilized by the NASA's Exercise Physiology Laboratory for pre- and post-flight testing astronauts assigned to ISS flights. Laboratory evaluation of the PFS demonstrated that it provides similar results to those measured by the reference metabolic gas analysis system. It is recommended that the PFS be incorporated into the standard periodic fitness evaluation testing performed onboard the ISS.
Author
Pulmonary Functions; Long Duration Space Flight; International Space Station; Space Flight; Exercise Physiology

20070032006 NASA Johnson Space Center, Houston, TX, USA
The Effect of Increasing Inertia upon Vertical Ground Reaction Forces during Locomotion
DeWitt, John K.; Hagan, R. Donald; Cromwell, Ronita L.; [2007]; 24 pp.; In English; No Copyright; Avail.: CASI: A03, Hardcopy

The addition of inertia to exercising astronauts could increase ground reaction forces and potentially provide a greater health benefit. However, conflicting results have been reported regarding the adaptations to additional mass (inertia) without additional net weight (gravitational force) during locomotion. We examined the effect of increasing inertia while maintaining net gravitational force on vertical ground reaction forces and kinematics during walking and running. Vertical ground reaction force was measured for ten healthy adults (5 male/5 female) during walking (1.34 m/s) and running (3.13 m/s) using a force-measuring treadmill. Subjects completed locomotion at normal weight and mass, and at 10, 20, 30, and 40% of added inertial force. The added gravitational force was relieved with overhead suspension, so that the net force between the subject and treadmill at rest remained equal to 100% body weight. Peak vertical impact forces and loading rates increased with increased inertia during walking, and decreased during running. As inertia increased, peak vertical propulsive forces decreased during walking and did not change during running. Stride time increased during walking and running, and contact time increased during running. Vertical ground reaction force production and adaptations in gait kinematics were different between walking and running. The increased inertial forces were utilized independently from gravitational forces by the motor control system when determining coordination strategies.
Author
Inertia; Physical Exercise; Bone Demineralization; Microgravity; Physiological Effects; Exercise Physiology; Gravitational Physiology; Aerospace Medicine

20070032016 NASA Johnson Space Center, Houston, TX, USA
Recovery of Spaceflight-induced Bone Loss: Bone Mineral Density after Long-Duration Missions as Fitted with an Exponential Function
Sibonga, J. D.; Evans, H. J.; Sung, H. G.; Spector, E. R.; Lang, T. F.; Oganov, V. S.; Bakulin, A. V.; Shackelford, L. C.; LeBlanc, A. D.; [2007]; 23 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS-9-99055; NNJ04HC7SA; Copyright; Avail.: CASI: A03, Hardcopy

The loss of bone mineral in NASA astronauts during spaceflight has been investigated throughout the more than 40 years of space travel. Consequently, it is a medical requirement at NASA Johnson Space Center (JSC) that changes in bone mass

be monitored in crew members by measuring bone mineral density (BMD) with dual-energy x-ray absorptiometry (DXA) before and after flight on astronauts who serve on long-duration missions (4-6 months). We evaluated this repository of medical data to track whether there is recovery of bone mineral that was lost during spaceflight. Our analysis was supplemented by BMD data from cosmonauts (by convention, a space traveler formally employed by the Russia Aviation and Space Agency or by the previous Soviet Union) who had also flown on long-duration missions. Data from a total of 45 individual crew members -- a small number of whom flew on more than one mission -- were used in this analysis. Changes in BMD (between 56 different sets of pre- and postflight measurements) were plotted as a function of time (days after landing). Plotted BMD changes were fitted to an exponential mathematical function that estimated: i) BMD change on landing day (day 0) and ii) the number of days after landing when 50% of the lost bone would be recovered ('50% recovery time') in the lumbar spine, trochanter, pelvis, femoral neck and calcaneus. In sum, averaged losses of bone mineral after long-duration spaceflight ranged between 2-9% across all sites with our recovery model predicting a 50% restoration of bone loss for all sites to be within 9 months.

Author

Bone Demineralization; Bone Mineral Content; Long Duration Space Flight; Physiological Effects; Osteogenesis; Time Dependence

20070032022 NASA Johnson Space Center, Houston, TX, USA

Aerospace Toxicology and Microbiology

James, John T.; Parmet, A. J.; Pierson, Duane L.; [2007]; 49 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Toxicology dates to the very earliest history of humanity with various poisons and venom being recognized as a method of hunting or waging war with the earliest documentation in the Evers papyrus (circa 1500 BCE). The Greeks identified specific poisons such as hemlock, a method of state execution, and the Greek word toxos (arrow) became the root of our modern science. The first scientific approach to the understanding of poisons and toxicology was the work during the late middle ages of Paracelsus. He formulated what were then revolutionary views that a specific toxic agent or 'toxicon' caused specific dose-related effects. His principles have established the basis of modern pharmacology and toxicology. In 1700, Bernardo Ramazzini published the book De Morbis Artificum Diatriba (The Diseases of Workers) describing specific illnesses associated with certain labor, particularly metal workers exposed to mercury, lead, arsenic, and rock dust. Modern toxicology dates from development of the modern industrial chemical processes, the earliest involving an analytical method for arsenic by Marsh in 1836. Industrial organic chemicals were synthesized in the late 1800 s along with anesthetics and disinfectants. In 1908, Hamilton began the long study of occupational toxicology issues, and by WW I the scientific use of toxicants saw Haber creating war gases and defining time-dosage relationships that are used even today.

Derived from text

Microbiology; Poisons; Toxicology; Aerospace Medicine; Hazardous Materials; Toxic Hazards; Flight Hazards; Biological Hazards

20070032036 Civil Aerospace Medical Inst., Oklahoma City, OK, USA

Intensity of the Internal Standard Response as the Basis for Reporting a Test Specimen as Negative or Inconclusive

Liu, Ray H.; Wu, Chih-Hung; Chen, Yi-Jun; Chang, Chiung-Dan; Linville, Jason G.; Canfield, Dennis V.; August 2007; 13 pp.; In English

Contract(s)/Grant(s): AM-B-07-TOX-206

Report No.(s): DOT/FAA/AM-07/23; Copyright; Avail.: CASI: A03, Hardcopy

Under normal circumstances, a test specimen is reported as 'negative' when the response of the analyte is absent. However, if the intensity of the internal standard (IS) is low, indicating interference factors, the test could be considered 'inconclusive.' A quantitative hypothesis, A = (RxIxS)/L, serves as the 'cutoff' for the acceptable signal-to-noise (SIN) ratio for the IS in making 'negativelinconclusive' decisions, where A: acceptable SIN ratio for internal standard; R: relative response bf the IS and the analyte (same concentration); I: concentration of the IS; S: (minimal SIN ratio); and L: limit of detection. The hypothesis was empirically tested using 9-carboxy-11-nor-Delta (sup 9)-tetrahydrocannabinol (THC-COOH) analyte, THC-COOH-4 IS, and ibuprofen and hydrogen peroxide (H2O2) as interference factors. Urine specimens containing 0-5 ng/mL of THC-COOH were spiked with various quantities of ibuprofen or H,O,, followed by liquid-liquid extraction, derivatization, and GC-MS analysis under selected-ion-monitoring mode. Among the 'adulterated' test specimens evaluated,

those with a S/N for the internal standard below the acceptable IS S/N 'A,' the quantitative criterion was indeed found to provide a useful guide for making negative/inconclusive decisions. This equation could be programmed into the instrument software to flag results as being inconclusive when they do not meet the criteria described in this paper.
Author
Signal to Noise Ratios; Pharmacology; Toxicology; Marijuana

20070032039 NASA Johnson Space Center, Houston, TX, USA
Autonomous Medical Care for Exploration Class Space Missions
Hamilton, Douglas; Smart, Kieran; Melton, Shannon; Polk, James D.; Johnson-Throop, Kathy; [2007]; 28 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS9-02078; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032039

The US-based health care system of the International Space Station (ISS) contains several subsystems, the Health Maintenance System, Environmental Health System and the Countermeasure System. These systems are designed to provide primary, secondary and tertiary medical prevention strategies. The medical system deployed in Low Earth Orbit (LEO) for the ISS is designed to enable a 'stabilize and transport' concept of operations. In this paradigm, an ill or injured crewmember would be rapidly evacuated to a definitive medical care facility (DMCF) on Earth, rather than being treated for a protracted period on orbit. The medical requirements of the short (7 day) and long duration (up to 6 months) exploration class missions to the Moon are similar to LEO class missions with the additional 4 to 5 days needed to transport an ill or injured crewmember to a DCMF on Earth. Mars exploration class missions are quite different in that they will significantly delay or prevent the return of an ill or injured crewmember to a DMCF. In addition the limited mass, power and volume afforded to medical care will prevent the mission designers from manifesting the entire capability of terrestrial care. NASA has identified five Levels of Care as part of its approach to medical support of future missions including the Constellation program. In order to implement an effective medical risk mitigation strategy for exploration class missions, modifications to the current suite of space medical systems may be needed, including new Crew Medical Officer training methods, treatment guidelines, diagnostic and therapeutic resources, and improved medical informatics.
Author
Aerospace Medicine; Health; Spacecrews; Therapy; Prevention; Space Missions; Astronaut Training; Aerospace Systems

20070032057 NASA Glenn Research Center, Cleveland, OH, USA
ECP Bone Workshop Day 2, Session 1: Validation of Exercise Countermeasures
Myers, Jerry G.; [2007]; 14 pp.; In English; 2007 Exercise Countermeasures Program Bone Workshop, 4-5 Oct. 2007, Houston, TX, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 516724.01.02.01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032057

The thesis of this session of the ECP Bone workshop is that computer modeling is required in order to evaluate factor of risk for fracture when considering the uniquely localized bone loss conditions experienced by Astronauts. This session provides an opportunity to introduce the Integrated Medical Model Bone Fracture Risk (IMM-BFxRM) simulation approach and how this and other models improve understanding of the effects of exercise countermeasures. This workshop session also provides an opportunity for the panel to provide recommendations on this and other 'complex modeling' approaches, as well as, the importance of funding the IMM-BFxRM and companion efforts by external scientists (Lang and Keyak).
Author
Bone Demineralization; Astronauts; Physical Exercise; Risk; Bones; Computerized Simulation

20070032687 NASA Johnson Space Center, Houston, TX, USA
Neurovestibular and Sensorimotor Studies in Space and Earth Benefits
Clement, Gilles; Reschke, Millard; Wood, Scott; [2005]; ISSN 1389-2010; 17 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

This review summarizes what has been learned from studies of human neurovestibular system in weightless conditions, including balance and locomotion, gaze control, vestibular-autonomic function and spatial orientation, and gives some examples of the potential Earth benefits of this research. Results show that when astronauts and cosmonauts return from space flight, both the peripheral and central neural processes are physiologically and functionally altered. There are clear distinctions between the virtually immediate adaptive compensations to weightlessness and those that require longer periods of time to

adapt. However, little is known to date about the adaptation of sensory-motor functions to long-duration space missions in weightlessness and to the transitions between various reduced gravitational levels, such as on the Moon and Mars. Results from neurovestibular research in space have substantially enhanced our understanding of the mechanisms and characteristics of postural, gaze, and spatial orientation deficits, analogous to clinical cases of labyrinthine-defective function. Also, space neurosciences research has participated in the development and application of significant new technologies, such as video recording and processing of three-dimensional eye movements and posture, hardware for the unencumbered measurement of head and body movement, and procedures for investigating otolith function on Earth. In particular, devices such as centrifugation or off-vertical axis rotation could enhance clinical neurological testing because it provides linear acceleration which specifically stimulates the otolith organs in a frequency range close to natural head and body movement.
Author
Astronauts; Cosmonauts; Autonomic Nervous System; Sensorimotor Performance; Long Duration Space Flight; Weightlessness; Vestibules; Eye Movements; Otolith Organs

20070032688 NASA Johnson Space Center, Houston, TX, USA
Varicella Zoster Virus in Saliva of Patients With Herpes Zoster
Mehta, Satish K.; Tyring, Stephen K.; Gilden, Donald H.; Cohrs, Randall J.; Leal, Melanie J.; Castro, Victoria A.; Feiveson, Alan H.; Ott, C. Mark; Pierson, Duane L.; [2007]; 11 pp.; In English; International Herpesvirus Workshop, July 2007, Asheville, NC, USA
Contract(s)/Grant(s): NIH AG06127; NIH NS32623; 111-30-10-03; 111-30-10-06; Copyright; Avail.: CASI: A03, Hardcopy

Background. VZV DNA is present in saliva of healthy astronauts and patients with Ramsay Hunt syndrome (geniculate zoster). We hypothesized that a prospective analysis of patients with zoster would detect VZV in saliva independent of zoster location. Methods. We treated 54 patients with valacyclovir. On the first treatment day, 7- and 14-days later, pain was scored and saliva examined for VZV DNA. Saliva from six subjects with chronic pain and 14 healthy subjects was similarly studied. Results. Follow-up data was available for 50/54 patients. Pain decreased in 43/50 (86 percent), disappeared in 37 (74 percent), recurred after disappearing in three (6 percent) and increased in four (8 percent). VZV DNA was found in every patient the day treatment was started, decreased in 47/50 (94 percent), transiently increased in three (6 percent) before decreasing, increased in two (4 percent) and disappeared in 41 (82 percent). There was a positive correlation between the presence of VZV DNA and pain, as well as between the VZV DNA copy number and pain ($P<0.0005$). Saliva of two patients was cultured, and infectious VZV was isolated from one. VZV DNA was present in one patient before rash and in four patients after pain resolved, and not in any control subjects. Conclusion. VZV DNA is present in saliva of zoster patients.
Author
Viral Diseases; Viruses; Saliva; Isolation

53
BEHAVIORAL SCIENCES

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

20070031829 NASA Johnson Space Center, Houston, TX, USA
A Review of Training Methods and Instructional Techniques: Implications for Behavioral Skills Training in U.S. Astronauts
Hysong, Sylvia J.; Galarza, Laura; Holland, Albert W.; [2007]; 32 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

Long-duration space missions (LDM) place unique physical, environmental and psychological demands on crewmembers that directly affect their ability to live and work in space. A growing body of research on crews working for extended periods in isolated, confined environments reveals the existence of psychological and performance problems in varying degrees of magnitude. The research has also demonstrated that although the environment plays a cathartic role, many of these problems are due to interpersonal frictions (Wood, Lugg, Hysong, & Harm, 1999), and affect each individual differently. Consequently, crewmembers often turn to maladaptive behaviors as coping mechanisms, resulting in decreased productivity and psychological discomfort. From this body of research, critical skills have been identified that can help a crewmember better navigate the psychological challenges of long duration space flight. Although most people lack several of these skills, most of them can be learned; thus, a training program can be designed to teach crewmembers effective leadership, teamwork, and self-care strategies that will help minimize the emergence of maladaptive behaviors. Thus, it is the purpose of this report is

twofold: 1) To review the training literature to help determine the optimal instructional methods to use in delivering psychological skill training to the U.S. Astronaut Expedition Corps, and 2) To detail the structure and content of the proposed Astronaut Expedition Corps Psychological Training Program.
Author
Astronaut Training; Long Duration Space Flight; Human Behavior; Education; Methodology

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*.

20070031842 NASA Johnson Space Center, Houston, TX, USA
Foods for a Mission to Mars: Equivalent System Mass and Development of a Multipurpose Small-Scale Seed Processor
Gandolph, J.; Chen, G.; Weiss, I.; Perchonok, D. M.; Wijeratne, W.; Fortune, S.; Corvalan, C.; Campanella, O.; Okos, M.; Mauer, L. J.; [2007]; 10 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

The candidate crops for planetary food systems include: wheat, white and sweet potatoes, soybean, peanut, strawberry, dry bean including lentil and pinto, radish, rice, lettuce, carrot, green onion, tomato, peppers, spinach, and cabbage. Crops such as wheat, potatoes, soybean, peanut, dry bean, and rice can only be utilized after processing, while others are classified as ready-to-eat. To process foods in space, the food processing subsystem must be capable of producing a variety of nutritious, acceptable, and safe edible ingredients and food products from pre-packaged and resupply foods as well as salad crops grown on the transit vehicle or other crops grown on planetary surfaces. Designing, building, developing, and maintaining such a subsystem is bound to many constraints and restrictions. The limited power supply, storage locations, variety of crops, crew time, need to minimize waste, and other equivalent system mass (ESM) parameters must be considered in the selection of processing equipment and techniques.
Derived from text
Farm Crops; Consumables (Spacecrew Supplies); Food Production (In Space); Mars Environment

20070031843 NASA Johnson Space Center, Houston, TX, USA
Foods for a Mission to Mars: Investigations of Low-Dose Gamma Radiation Effects
Gandolph, J.; Shand, A.; Stoklosa, A.; Ma, A.; Weiss, I.; Alexander, D.; Perchonok, M.; Mauer, L. J.; [2007]; 21 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG5-12686; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031843

Food must be safe, nutritious, and acceptable throughout a long duration mission to maintain the health, well-being, and productivity of the astronauts. In addition to a developing a stable pre-packaged food supply, research is required to better understand the ability to convert edible biomass into safe, nutritious, and acceptable food products in a closed system with many restrictions (mass, volume, power, crew time, etc.). An understanding of how storage conditions encountered in a long-term space mission, such as elevated radiation, will impact food quality is also needed. The focus of this project was to contribute to the development of the highest quality food system possible for the duration of a mission, considering shelf-stable extended shelf-life foods, bulk ingredients, and crops to be grown in space. The impacts of space-relevant radiation doses on food, bulk ingredient, and select candidate crop quality and antioxidant capacity were determined. Interestingly, increasing gamma-radiation doses (0 to 1000 Gy) did not always increase dose-related effects in foods. Intermediate radiation doses (10 to 800Gy) often had significantly larger impact on the stability of bulk ingredient oils than higher (1000Gy) radiation doses. Overall, most food, ingredient, and crop systems investigated showed no significant differences between control samples and those treated with 3 Gy of gamma radiation (the upper limit estimated for a mission to Mars). However, this does not mean that all foods will be stable for 3-5 years, nor does it mean that foods are stable to space radiation comprising more than gamma rays.
Author
Extraterrestrial Radiation; Farm Crops; Mars Missions; Radiation Effects; Storage Stability; Preserving; Space Flight Feeding

20070031916 NASA Marshall Space Flight Center, Huntsville, AL, USA

Life Support Requirements and Challenges for NASA's Constellation Program

Carasquillo, Robyn; May 20, 2007; 1 pp.; In English; 16th IAA Humans in Space Symposium, 20-24 May 2007, Beijing, China; No Copyright; Avail.: Other Sources; Abstract Only

NASA's Constellation Program, which includes the mission objectives of establishing a permanently-manned lunar Outpost, and the exploration of Mars, poses new and unique challenges for human life support systems that will require solutions beyond the Shuttle and International Space Station state of the art systems. In particular, the requirement to support crews for 210 days duration at the lunar outpost with limited resource resupply capability wilt require closed-loop regenerative life support systems with minimal expendables. Planetary environmental conditions such as lunar dust and extreme temperatures, as well as the capability to support frequent and extended-duration EVA's will be particularly challenging. This presentation will summarize the key program and mission life support requirements for the Constellation Program and the unique challenges they present for technology and architecture development.

Author

Constellation Program; Life Support Systems; Feedback Control; Extravehicular Activity; Mission Planning; International Space Station

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*.

20070032682 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Remote Sensing Data Visualization, Fusion and Analysis via Giovanni

Leptoukh, G.; Zubko, V.; Gopalan, A.; Khayat, M.; June 25, 2007; 4 pp.; In English; 32nd International Symposium on Remote Sensing of Environment, 25-29 Jun. 2007, San Jose, Costa Rica; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

We describe Giovanni, the NASA Goddard developed online visualization and analysis tool that allows users explore various phenomena without learning remote sensing data formats and downloading voluminous data. Using MODIS aerosol data as an example, we formulate an approach to the data fusion for Giovanni to further enrich online multi-sensor remote sensing data comparison and analysis.

Author

Remote Sensing; Multisensor Applications; Scientific Visualization; MODIS (Radiometry); Interfaces; Multisensor Fusion

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*.

20070031810 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Data Converters Performance at Extreme Temperatures

Rejeshuni, Rarnesham; Kumar, Nikil; Mao, James; Keymeulen, Didier; Zebulum, Ricardo S.; Stoica, Adrian; March 4, 2006; 10 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40194

Space missions often require radiation and extreme-temperature hardened electronics to survive the harsh environments beyond earth's atmosphere. Traditional approaches to preserve electronics incorporate shielding, insulation and redundancy at the expense of power and weight. However, a novel way of bypassing these problems is the concept of evolutionary hardware. A reconfgurable device, consisting of several switches interconnected with analog/digital parts, is controlled by an evolutionary processor (EP). When the EP detects degradation in the circuit it sends signals to reconfgure the switches, thus forming a new circuit with the desired output. This concept has been developed since the mid-90s, but one problem remains - the EP cannot degrade substantially. For this reason, extensive testing at extreme temperatures (-180' to 120(deg)C) has been done on devices found on FPGA boards (taking the role of the EP) such as the Analog to Digital and the Digital to Analog

Converter. Analysis of the results has shown that FPGA boards implementing EP with some compensation may be a practical solution to evolving circuits. This paper describes results on the tests of data converters at extreme temperatures.
Author
Digital to Analog Converters; Reconfigurable Hardware; Space Missions; Data Converters; Switches

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.

20070031775 California Inst. of Tech., Pasadena, CA, USA
New Software for Ensemble Creation in the Spitzer-Space-Telescope Operations Database
Laher, Russ; Rector, John; October 24, 2004; 4 pp.; In English; Astronomical Data Analysis Software and Systems XIV, 24-27 October 2004, Pasadena, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources ONLINE: http://hdl.handle.net/2014/40209

Some of the computer pipelines used to process digital astronomical images from NASA's Spitzer Space Telescope require multiple input images, in order to generate high-level science and calibration products. The images are grouped into ensembles according to well documented ensemble-creation rules by making explicit associations in the operations Informix database at the Spitzer Science Center (SSC). The advantage of this approach is that a simple database query can retrieve the required ensemble of pipeline input images. New and improved software for ensemble creation has been developed. The new software is much faster than the existing software because it uses pre-compiled database stored-procedures written in Informix SPL (SQL programming language). The new software is also more flexible because the ensemble creation rules are now stored in and read from newly defined database tables. This table-driven approach was implemented so that ensemble rules can be inserted, updated, or deleted without modifying software.
Author
Space Infrared Telescope Facility; Programming Languages; Computer Programs; Calibrating; Data Bases

20070031804 NASA Glenn Research Center, Cleveland, OH, USA
IceVal DatAssistant: An Interactive, Automated Icing Data Management System
Levinson, Laurie H.; Wright, William B.; [2007]; 16 pp.; In English; 46th AIAA Aerospace Sciences Meeting and Exhibit, 7-10 Jan. 2008, Reno, NV, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 645846.02.07.03.04.01; Copyright; Avail.: CASI: A03, Hardcopy

As with any scientific endeavor, the foundation of icing research at the NASA Glenn Research Center (GRC) is the data acquired during experimental testing. In the case of the GRC Icing Branch, an important part of this data consists of ice tracings taken following tests carried out in the GRC Icing Research Tunnel (IRT), as well as the associated operational and environmental conditions during those tests. Over the years, the large number of experimental runs completed has served to emphasize the need for a consistent strategy to manage the resulting data. To address this situation, the Icing Branch has recently elected to implement the IceVal DatAssistant automated data management system. With the release of this system, all publicly available IRT-generated experimental ice shapes with complete and verifiable conditions have now been compiled into one electronically-searchable database; and simulation software results for the equivalent conditions, generated using the latest version of the LEWICE ice shape prediction code, are likewise included and linked to the corresponding experimental runs. In addition to this comprehensive database, the IceVal system also includes a graphically-oriented database access utility, which provides reliable and easy access to all data contained in the database. In this paper, the issues surrounding historical icing data management practices are discussed, as well as the anticipated benefits to be achieved as a result of migrating to the new system. A detailed description of the software system features and database content is also provided; and, finally, known issues and plans for future work are presented.
Author
Automatic Control; Data Management; Ice Formation; Computer Systems Programs; Computer Graphics

20070031886 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Real Time Mission Monitor: A Situational Awareness Tool For Managing Experiment Assets
Blakeslee, Richard; Hall, John; Goodman, Michael; Parker, Philip; Freudinger, Larry; He, Matt; [2007]; 5 pp.; In English; NASA Science Technology Conference, 19-21 Jun. 2007, Adelphi, MD, USA; Copyright; Avail.: CASI: A01, Hardcopy

The NASA Real Time Mission Monitor (RTMM) is a situational awareness tool that integrates satellite, airborne and

surface data sets; weather information; model and forecast outputs; and vehicle state data (e.g., aircraft navigation, satellite tracks and instrument field-of-views) for field experiment management RTMM optimizes science and logistic decision-making during field experiments by presenting timely data and graphics to the users to improve real time situational awareness of the experiment's assets. The RTMM is proven in the field as it supported program managers, scientists, and aircraft personnel during the NASA African Monsoon Multidisciplinary Analyses experiment during summer 2006 in Cape Verde, Africa. The integration and delivery of this information is made possible through data acquisition systems, network communication links and network server resources built and managed by collaborators at NASA Dryden Flight Research Center (DFRC) and Marshall Space Flight Center (MSFC). RTMM is evolving towards a more flexible and dynamic combination of sensor ingest, network computing, and decision-making activities through the use of a service oriented architecture based on community standards and protocols.
Author
Situational Awareness; Software Development Tools; Service Oriented Architecture; Real Time Operation; Satellite Tracking; Navigation Satellites; Data Acquisition; Communication Networks

20070032059 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
RTSJ Memory Areas and Their Affects on the Performance of a Flight-Like Attitude Control System
Niessner, Albert F.; Benowitz, Edward G.; November 2003; 13 pp.; In English; JAVA Technology for Real-Time Embedded Systems, November 2003, Sicily, Italy; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40152

The two most important factors in improving performance in any software system, but especially a real-time, embedded system, are knowing which components are the low performers and knowing what can be done to improve their performance. The word performance with respect to a real-time, embedded system does not necessarily mean fast execution, which is the common definition when discussing non real-time systems. It also includes meeting all of the specified execution dead-lines and executing at the correct time without sacrificing non real-time performance. Using a Java prototype of an existing control system used on Deep Space 1[1], the effects from adding memory areas are measured and evaluated with respect to improving performance.
Author
Attitude Control; Memory (Computers); Prototypes; Computer Systems Performance; Software Engineering; Real Time Operation; Embedded Computer Systems; Java (Programming Language); Control Systems Design

20070032676 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
The Mars Exploration Rover Surface Mobility Flight Software: Driving Ambition
Biesiadecki, Jeffrey J.; Maimone, Mark W.; March 2006; 30 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations
Report No.(s): CL#06-0060; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40221

In this paper we describe the software that has driven these rovers more than a combined 11,000 meters over the Martian surface, including its design and implementation, and summarize current mobility performance results from Mars.
Author
Roving Vehicles; Mars Surface; Mars Exploration

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.

20070032033 NASA Marshall Space Flight Center, Huntsville, AL, USA
CREME96 Update/Replacement Efforts
Adams, Jim H.; [2007]; 20 pp.; In English; Single Event Effects Symposium, 10-12 Apr. 2007, Long Beach, CA, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032033

This talk concerns the plans to update the CREME96 model that is currently available on the WWW. The talk states the reasons for updating CREME. It describes the updates that are planned, including the single event prediction paradigm, the

method of radiation transport through the spacecraft to the electronic component of interest and the planned updates to models for the space radiation environment. It also reviews user suggestions received do date for the update.
Author
Extraterrestrial Radiation; Prediction Analysis Techniques; Spacecraft Components; Single Event Upsets; Mathematical Models

20070032093 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Model Output Is Data, Too: And Other Futuristic Views
Szabo, A.; December 11, 2006; 1 pp.; In English; American Geophysical Union Conference, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The NASA space science data environment has been undergoing significant changes during the past decade: Data has become significantly more voluminous and more varied. At the same time it became much more openly available to the scientific community. As a result a number of efforts have been made to document the data content at NSSDC/SPDF, PDS, the ISTP program and more recently as part of the newly developing Virtual Observatories. Concurrently, our need to access data has become much more immediate dictating a distributed environment where users can obtain their data directly from the production sites. But where does this change lead? And what more needs to be done to further enable scientific productivity? A view of our data system 5- years in the future will be offered that envisions distributed data processing services whereby the user can obtain the type of data that is needed not necessarily what is produced. Moreover, in an ideal system the means should exist to treat models as instruments allowing the ready mixing of their output with spacecraft generated data.
Author
Aerospace Sciences; Data Processing; Models; Data Systems

20070032627 NASA Goddard Space Flight Center, Greenbelt, MD, USA
High Performance Processors for Space Environments: A Subproject of the NASA Exploration Missions Systems Directorate 'Radiation Hardened Electronics for Space Environments' Technology Development Program
Johnson, M.; Label, K.; McCabe, J.; Powell, W.; Bolotin, G.; Kolawa, E.; Ng, T.; Hyde, D.; March 19, 2007; 3 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032627

Implementation of challenging Exploration Systems Missions Directorate objectives and strategies can be constrained by onboard computing capabilities and power efficiencies. The Radiation Hardened Electronics for Space Environments (RHESE) High Performance Processors for Space Environments project will address this challenge by significantly advancing the sustained throughput and processing efficiency of high-per$ormance radiation-hardened processors, targeting delivery of products by the end of FY12.
Author
Aerospace Engineering; Power Efficiency; Aerospace Environments; NASA Programs

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.*

20070031901 NASA Johnson Space Center, Houston, TX, USA
Robotics
Ambrose, Robert O.; [2007]; 2 pp.; In English; ESMD Technology Exchange Conference, 14-15 Nov. 2007, Galveston, TX, USA
Contract(s)/Grant(s): 986249.01.11.20.17.10; No Copyright; Avail.: Other Sources; Abstract Only

Lunar robotic functions include: 1. Transport of crew and payloads on the surface of the moon; 2. Offloading payloads from a lunar lander; 3. Handling the deployment of surface systems; with 4. Human commanding of these functions from inside a lunar vehicle, habitat, or extravehicular (space walk), with Earth-based supervision. The systems that will perform these functions may not look like robots from science fiction. In fact, robotic functions may be automated trucks, cranes and winches. Use of this equipment prior to the crew s arrival or in the potentially long periods without crews on the surface, will require that these systems be computer controlled machines. The public release of NASA's Exploration plans at the 2nd Space Exploration Conference (Houston, December 2006) included a lunar outpost with as many as four unique mobility chassis

designs. The sequence of lander offloading tasks involved as many as ten payloads, each with a unique set of geometry, mass and interface requirements. This plan was refined during a second phase study concluded in August 2007. Among the many improvements to the exploration plan were a reduction in the number of unique mobility chassis designs and a reduction in unique payload specifications. As the lunar surface system payloads have matured, so have the mobility and offloading functional requirements. While the architecture work continues, the community can expect to see functional requirements in the areas of surface mobility, surface handling, and human-systems interaction as follows: Surface Mobility 1. Transport crew on the lunar surface, accelerating construction tasks, expanding the crew s sphere of influence for scientific exploration, and providing a rapid return to an ascent module in an emergency. The crew transport can be with an un-pressurized rover, a small pressurized rover, or a larger mobile habitat. 2. Transport Extra-Vehicular Activity (EVA) equipment and construction payloads. 3. Transport habitats and power modules over long distances, pre-positioning them for the arrival of crew on a subsequent lander. Surface Handling 1. Offload surface system payloads from the lander, breaking launch restraints and power/data connections. Payloads may be offloaded to a wheeled vehicle for transport. 2. Deploy payloads from a wheeled vehicle at a field site, placing the payloads in their final use site on the ground or mating them with existing surface systems. 3. Support regolith collection, site preparation, berm construction, or other civil engineering tasks using tools and implements attached to rovers. Human-Systems Interaction 1. Provide a safe command and control interface for suited EVA to ride on and drive the vehicles, making sure that the systems are also safe for working near dismounted crew. 2. Provide an effective control system for IV crew to tele-operate vehicles, cranes and other equipment from inside the surface habitats with evolving independence from Earth. .. Provide a supervisory system that allows machines to be commanded from the ground, working across the Earth-Lunar time delays on the order of 5-10 seconds (round trip) to support operations when crew are not resident on the surface. Technology Development Needs 1. Surface vehicles that can dock, align and mate with outpost equipment such as landers, habitats and fluid/power interfaces. 2. Long life motors, drive trains, seals, motor electronics, sensors, processors, cable harnesses, and dash board displays. 3. Active suspension control, localization, high speed obstacle avoidance, and safety systems for operating near dismounted crew. 4. High specific energy and specific power batteries that are safe, rechargeable, and long lived.

Author

Functional Design Specifications; Lunar Bases; Lunar Surface; Payloads; Robotics; Robots; Roving Vehicles; Lunar Based Equipment; Man Machine Systems; Robot Dynamics; Teleoperators

64
NUMERICAL ANALYSIS

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

20070031999 NASA Marshall Space Flight Center, Huntsville, AL, USA

Dynamic Theory of Relativistic Electrons Stochastic Heating by Whistler Mode Waves with Application to the Earth Magnetosphere

Khazanov, G. V.; Tel'nikhin, A. A.; Kronberg, T. K.; [2007]; 39 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

In the Hamiltonian approach an electron motion in a coherent packet of the whistler mode waves propagating along the direction of an ambient magnetic field is studied. The physical processes by which these particles are accelerated to high energy are established. Equations governing a particle motion were transformed in to a closed pair of nonlinear difference equations. The solutions of these equations have shown there exists the energetic threshold below that the electron motion is regular, and when the initial energy is above the threshold an electron moves stochastically. Particle energy spectra and pitch angle electron scattering are described by the Fokker-Planck-Kolmogorov equations. Calculating the stochastic diffusion of electrons due to a spectrum of whistler modes is presented. The parametric dependence of the diffusion coefficients on the plasma particle density, magnitude of wave field, and the strength of magnetic field is studies. It is shown that significant pitch angle diffusion occurs for the Earth radiation belt electrons with energies from a few keV up to a few MeV.

Author

Relativistic Particles; Stochastic Processes; Whistlers; Electron Scattering; Earth Magnetosphere; Heating; Hamiltonian Functions

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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*.

20070031753 NASA Marshall Space Flight Center, Huntsville, AL, USA

Reply to 'Comment on 'A Self-Consistent Model of the Interacting Ring Current Ions and Electromagnetic Ion Cyclotron Waves, Initial Results: Waves and Precipitation Fluxes' and 'Self-Consistent Model of the Magnetospheric Ring Current and Propagating Electromagnetic Ion Cyclotron Waves: Waves in Multi-Ion Magnetosphere' by Khazanov et al. et al.'

Khazanov, G. V.; Gamayunov, K. V.; Gallagher, D. L.; Kozyra, J. W.; [2007]; 18 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

It is well-known that the effects of electromagnetic ion cyclotron (EMIC) waves on ring current (RC) ion and radiation belt (RB) electron dynamics strongly depend on such particle/wave characteristics as the phase-space distribution function, frequency, wavenormal angle, wave energy, and the form of wave spectral energy density. The consequence is that accurate modeling of EMIC waves and RC particles requires robust inclusion of the interdependent dynamics of wave growth/damping, wave propagation, and[particles. Such a self-consistent model is being progressively developed by Khazanov et al. [2002, 2006, 2007]. This model is based on a system of coupled kinetic equations for the RC and EMIC wave power spectral density along with the ray tracing equations. Thome and Home [2007] (hereafter referred to as TH2007) call the Khazanov et al. [2002, 2006] results into question in their Comment. The points in contention can be summarized as follows. TH2007 claim that: (1) 'the important damping of waves by thermal heavy ions is completely ignored', and Landau damping during resonant interaction with thermal electrons is not included in our model; (2) EMIC wave damping due to RC O + is not included in our simulation; (3) non-linear processes limiting EMIC wave amplitude are not included in our model; (4) growth of the background fluctuations to a physically significantamplitude'must occur during a single transit of the unstable region' with subsequent damping below bi-ion latitudes,and consequently'the bounce averaged wave kinetic equation employed in the code contains a physically erroneous 'assumption'. Our reply will address each of these points as well as other criticisms mentioned in the Comment. TH2007 are focused on two of our papers that are separated by four years. Significant progress in the self-consistent treatment of the RC-EMIC wave system has been achieved during those years. The paper by Khazanov et al. [2006] presents the latest version of our model, and in this Reply we refer mostly to this paper.

Author

Electromagnetic Radiation; Ion Cyclotron Radiation; Radiation Belts; Ring Currents; Wave Propagation

20070031920 NASA Langley Research Center, Hampton, VA, USA

Hypervelocity Impact (HVI), Volume 1, General Introduction

Gorman, Michael R.; Ziola, Steven M.; September 2007; 33 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06

Report No.(s): NASA/CR-2007-214885/VOL1; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031920

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. This volume contains an executive summary, overview of the method, brief descriptions of all targets, and highlights of results and conclusions.

Author

Hypervelocity Impact; Space Shuttles; Leading Edges; Impact Tests; Test Facilities

20070031921 NASA Langley Research Center, Hampton, VA, USA

Hypervelocity Impact (HVI), Volume 2, WLE Small-Scale Fiberglass Panel Flat Multi-Layer Targets A-1, A-2, and B-1

Gorman, Michael R.; Ziola, Steven M.; September 2007; 69 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06

Report No.(s): NASA/CR-2007-214885/VOL2; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031921

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted

hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Targets A-1, A-2, and B-2 was to study hypervelocity impacts through multi-layered panels simulating Whipple shields on spacecraft. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.
Author
Hypervelocity Impact; Glass Fibers; Panels; Leading Edges; Simulation; Wings; Targets; Impact Tests

20070031923 NASA Langley Research Center, Hampton, VA, USA
Hypervelocity Impact (HVI), Volume 4, WLE Small-Scale Fiberglass Panel Flat Target C-2
Gorman, Michael R.; Ziola, Steven M.; September 2007; 83 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06
Report No.(s): NASA/CR-2007-214885/VOL4; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031923

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Target C-2 was to study impacts through the reinforced carboncarbon (RCC) panels of the Wing Leading Edge. Fiberglass was used in place of RCC in the initial tests. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.
Author
Glass Fibers; Hypervelocity Impact; Leading Edges; Panels; Targets; Wings; Space Shuttles; Carbon-Carbon Composites

20070031924 NASA Langley Research Center, Hampton, VA, USA
Hypervelocity Impact (HVI), Volume 5, WLE High Fidelity Specimen Fg(RCC)-1
Gorman, Michael R.; Ziola, Steven M.; September 2007; 178 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06
Report No.(s): NASA/CR-2007-214885/VOL5; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031924

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods. The objective of Target Fg(RCC)-1 was to study hypervelocity impacts through the reinforced carbon-carbon (RCC) panels of the Wing Leading Edge. Fiberglass was used in place of RCC in the initial tests. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight.
Author
Carbon-Carbon Composites; Hypervelocity Impact; Impact Damage; Impact Tests; Leading Edges; Wings; Space Shuttles

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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*.

20070031764 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA
Finite Element Development and Specifications of a Patched, Recessed Nomex Core Honeycomb Panel for Increased Sound Transmission Loss
Grosveld, Ferdinand W.; September 2007; 160 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-00135B; WBS 561581.02.08.07.18.02
Report No.(s): NASA/CR-2007-214898; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031764

This informal report summarizes the development and the design specifications of a recessed nomex core honeycomb panel in fulfillment of the deliverable in Task Order 13RBE, Revision 10, Subtask 17. The honeycomb panel, with 0.020-inch thick aluminum face sheets, has 0.016-inch thick aluminum patches applied to twenty-five, 6 by 6 inch, quarter inch thick

recessed cores. A 10 dB higher transmission loss over the frequency range 250 - 1000 Hz was predicted by a MSC/NASTRAN finite element model when compared with the transmission loss of the base nomex core honeycomb panel. The static displacement, due to a unit force applied at either the core or recessed core area, was of the same order of magnitude as the static displacement of the base honeycomb panel when exposed to the same unit force. The mass of the new honeycomb design is 5.1% more than the base honeycomb panel. A physical model was constructed and is being tested.
Author
Honeycomb Structures; Design Analysis; Metal Sheets; Finite Element Method; Transmission Loss; Sound Transmission

73
NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

20070032069 NASA Marshall Space Flight Center, Huntsville, AL, USA
High Fidelity Thermal Simulators for Non-Nuclear Testing: Analysis and Initial Results
Bragg-Sitton, Shannon M.; Dickens, Ricky; Dixon, David; June 24, 2007; 10 pp.; In English; American Nuclear Society Space Nuclear Conference (SNC) 2007, 24-28 Jun. 2007, Boston, MA, USA; Original contains black and white illustrations
Report No.(s): Paper 2047; Copyright; Avail.: CASI: A02, Hardcopy

Non-nuclear testing can be a valuable tool in the development of a space nuclear power system, providing system characterization data and allowing one to work through various fabrication, assembly and integration issues without the cost and time associated with a full ground nuclear test. In a non-nuclear test bed, electric heaters are used to simulate the heat from nuclear fuel. Testing with non-optimized heater elements allows one to assess thermal, heat transfer, and stress related attributes of a given system, but fails to demonstrate the dynamic response that would be present in an integrated, fueled reactor system. High fidelity thermal simulators that match both the static and the dynamic fuel pin performance that would be observed in an operating, fueled nuclear reactor can vastly increase the value of non-nuclear test results. With optimized simulators, the integration of thermal hydraulic hardware tests with simulated neutronie response provides a bridge between electrically heated testing and fueled nuclear testing, providing a better assessment of system integration issues, characterization of integrated system response times and response characteristics, and assessment of potential design improvements' at a relatively small fiscal investment. Initial conceptual thermal simulator designs are determined by simple one-dimensional analysis at a single axial location and at steady state conditions; feasible concepts are then input into a detailed three-dimensional model for comparison to expected fuel pin performance. Static and dynamic fuel pin performance for a proposed reactor design is determined using SINDA/FLUINT thermal analysis software, and comparison is made between the expected nuclear performance and the performance of conceptual thermal simulator designs. Through a series of iterative analyses, a conceptual high fidelity design can developed. Test results presented in this paper correspond to a 'first cut' simulator design for a potential liquid metal (NaK) cooled reactor design that could be applied for Lunar surface power. Proposed refinements to this simulator design are also presented.
Author
Simulators; Heaters; Nuclear Fuels; Fission; Reactor Design; Fabrication; Thermal Analysis

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*.

20070031797 Universities Space Research Association, Lanham, MD, USA
An Evaluation of Grazing-Incidence Optics for Neutron Imaging
Gubarev, M. V.; [2007]; 17 pp.; In English; Instrument Seminar Center for Neutron Research at National Institute of Technology (NIST), 20 Apr. 2007, Gaithersburg, MD, USA; Original contains black and white illustrations; Copyright;
Avail.: CASI: A03, Hardcopy

The refractive index for most materials is slightly less than unity, which opens an opportunity to develop the grazing incidence neutron imaging optics. The ideal material for the optics would be natural nickel and its isotopes. Marshall Space Flight Center (MSFC) has active development program on the nickel replicated optics for use in x-ray astronomy. Brief status

report on the program is presented. The results of the neutron focusing optic test carried by the MSFC team at National Institute of Standards and Technology (NIST) are also presented. Possible applications of the optics are briefly discussed.
Author
Grazing Incidence; Refractivity; Imaging Techniques; Neutron Beams; X Ray Optics

20070031875 NASA Langley Research Center, Hampton, VA, USA
GIFTS SM EDU Data Processing and Algorithms
Tian, Jialin; Johnson, David G.; Reisse, Robert A.; Gazarik, Michael J.; July 27, 2007; 4 pp.; In English; 27th IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2007), 23-27 Jul. 2007, Barcelona, Spain; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

The Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) Sensor Module (SM) Engineering Demonstration Unit (EDU) is a high resolution spectral imager designed to measure infrared (IR) radiances using a Fourier transform spectrometer (FTS). The GIFTS instrument employs three Focal Plane Arrays (FPAs), which gather measurements across the long-wave IR (LWIR), short/mid-wave IR (SMWIR), and visible spectral bands. The raw interferogram measurements are radiometrically and spectrally calibrated to produce radiance spectra, which are further processed to obtain atmospheric profiles via retrieval algorithms. This paper describes the processing algorithms involved in the calibration stage. The calibration procedures can be subdivided into three stages. In the pre-calibration stage, a phase correction algorithm is applied to the decimated and filtered complex interferogram. The resulting imaginary part of the spectrum contains only the noise component of the uncorrected spectrum. Additional random noise reduction can be accomplished by applying a spectral smoothing routine to the phase-corrected blackbody reference spectra. In the radiometric calibration stage, we first compute the spectral responsivity based on the previous results, from which, the calibrated ambient blackbody (ABB), hot blackbody (HBB), and scene spectra can be obtained. During the post-processing stage, we estimate the noise equivalent spectral radiance (NESR) from the calibrated ABB and HBB spectra. We then implement a correction scheme that compensates for the effect of fore-optics offsets. Finally, for off-axis pixels, the FPA off-axis effects correction is performed. To estimate the performance of the entire FPA, we developed an efficient method of generating pixel performance assessments. In addition, a random pixel selection scheme is designed based on the pixel performance evaluation.
Author
Sensors; Engineering; Algorithms; Modules; Data Processing; Geosynchronous Orbits; Imaging Techniques

20070031918 NASA Marshall Space Flight Center, Huntsville, AL, USA
An Evaluation of Grazing-Incidence Optics for Neutron Imaging
Gubarev, M. V.; Ramsey, B. D.; Engelhaupt, D. E.; Burgess, J.; Mildner, D. F. R.; [2007]; 6 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC8-259; Copyright; Avail.: CASI: A02, Hardcopy

The focusing capabilities of neutron imaging optic based on the Wolter-1 geometry have been successfully demonstrated with a beam of long wavelength neutrons with low angular divergence.. A test mirror was fabricated using an electroformed nickel replication process at Marshall Space Flight Center. The neutron current density gain at the focal spot of the mirror is found to be at least 8 for neutron wavelengths in the range from 6 to 20 A. Possible applications of the optics are briefly discussed.
Author
Grazing Incidence; Neutron Flux Density; Neutron Beams; Imaging Techniques; Electroforming

20070032032 Fish and Richardson, San Diego, CA, USA
Two Dimensional Range-Imaging
Pain, Bedabrata, Inventor; Hancock, Bruce, Inventor; 3 Nov. 2005; 16 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS7-1407
Patent Info.: Filed 20 Jan. 2005; US-Patent-Appl-SN-11-040-217; US 2005/0243302
Report No.(s): PB2007-104057; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032032

A two-dimensional range-imaging system is capable of transmitting light from a source into a field of view and focusing return portions of the light, reflected off targets in the field of view, onto a two-dimensional array of photodetectors. The

photodectectors convert the return portions of light into electric signals that are compatible with a solid state circuit. Each electric signal is combined with a one or more reference signals to indicate a distance between the source and an associated target.
Author
Imaging Techniques; Photometers; Image Processing; Two Dimensional Bodies

20070032080 NASA Langley Research Center, Hampton, VA, USA
A Deeper Look at the Fundamentals of Heterodyne Detection Requirements
Roychoudhuri, Chandrasekhar; Prasad, Narasimha S.; July 08, 2007; 4 pp.; In English; 14th Coherent Laser Radar Conference, 8-13 Jul. 2007, Snowmass, CO, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 478643.02.02.02.15; Copyright; Avail.: CASI: A01, Hardcopy

We generally accept the experimentally observed criteria for heterodyne detections that the two waves that are mixed must (i) be collinear, (ii) have matched wave fronts and (iii) cannot be orthogonally polarized. We have not found in the literature adequate physical explanations for these requirements. The purpose of this paper is to find deeper physical understanding of the coherent heterodyne detection processes that could lead to better coherent laser radar system designs1. We find that there are a number of unresolved paradoxes in classical and quantum optics regarding the definitions and understanding of the 'interference' and 'coherence' properties of light, which are attributed as essentially due to inherent properties of the EM waves. A deeper exploration indicates that it is the various quantum mechanical properties of the detecting material dipoles that make light detectable (visible, or measurable) to us. Accordingly, all the properties that we generally attribute to only light, are in reality manifestations of collective properties of dipole-light interactions. 'Interference' and 'coherence' can be better understood in terms of this mutual interaction, followed by energy absorption by the dipoles from EM wave fields, manifesting in some measurable transformation of the detecting dipoles. Light beams do not interfere by themselves. The superposition effects due to light beams become manifest through the response characteristics of the detecting dipoles. In this paper, we will show some preliminary experimental results that clearly demonstrate that the heterodyning wave fronts have quantitative degradation in signal generation as the angle between them deviates from perfect collinearity. Subsequently, we will propose a hypothesis for this behavior. We will present experimental data establishing that the so called incoherent light can be detected through heterodyne mixing as long as the pulse length contained in the 'incoherent' light is longer than the response time of the detector. We will also present a correspondingly better interpretation of two distinguishable coherence properties, temporal coherence and spectral coherence. Our investigation provides a deeper insight into how to relax various system requirements for heterodyne detection and accordingly develop systems that are simpler, more reliable and lower in cost. Also, we believe that engineering of detector architecture by appropriately modifying dipole behavior using emerging nanotechnology to optimize heterodyne efficiency will be advantageous.
Author
Detection; Optical Heterodyning; Optical Radar

20070032106 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Zernike-like Orthogonal Basis Functions for Wavefront Characterization over Sampled, Irregular Apertures
Aronstein, David L.; Dean, Bruce H.; Smith, J. Scott; August 26, 2007; 1 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San DIego, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

For optical systems with circular apertures, wavefronts are often analyzed using Zernike polynomials, and individual Zernike functions are associated with familiar optical aberrations. For systems with noncircular apertures, or in practical situations in which wavefronts are measured at a limited number of points in the aperture, the Zernike polynomials are no longer an orthogonal basis for the measured data. Although there are an endless number of ways to create a basis for such measured data, a 'Zernike-like' basis is useful to connect with our experience with the usual optical aberrations. In this paper, the steps required to identify a Zernike-like basis for wavefronts over sampled, irregular apertures are presented, based on the Gram-Schmidt orthogonalization technique. The benefits of analyzing optical wavefronts using an orthogonal basis specific to an optical system's aperture shape and wavefront sampling, instead of using the traditional Zernike polynomials, are detailed in two examples, from image-based wavefront sensing on a segmented-aperture telescope (the James Webb Space Telescope Testbed Telescope at Ball Aerospace) and from interferometer characterization for surface metrology of a hexagonal mirror segment.
Author
Apertures; Mirrors; Wave Fronts; James Webb Space Telescope; Image Analysis; Interferometers

20070032304 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The NIRCam Optical Telescope Simulator (NOTES)

Kubalak, David; Hakun, Claef; Greeley, Bradford; Eichorn, William; Leviton, Douglas; Guishard, Corina; Gong, Qian; Warner, Thomas; Bugby, David; Robinson, Frederick; Lansing, Peter; Garza, Mario; Kirk, Jeffrey; [2007]; 1 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The Near Infra-Red Camera (NIRCam), the 0.6-5.0 micron imager and wavefront sensing instrument for the James Webb Space Telescope (JWST), will be used on orbit both as a science instrument, and to tune the alignment of the telescope. The NIRCam Optical Telescope Element Simulator (NOTES) will be used during ground testing to provide an external stimulus to verify wavefront error, imaging characteristics, and wavefront sensing performance of this crucial instrument. NOTES is being designed and built by NASA Goddard Space Flight Center with the help of Swales Aerospace and Orbital Sciences Corporation. It is a single-point imaging system that uses an elliptical mirror to form an U20 image of a point source. The point source will be fed via optical fibers from outside the vacuum chamber. A tip/tilt mirror is used to change the chief ray angle of the beam as it passes through the aperture stop and thus steer the image over NIRCam's field of view without moving the pupil or introducing field aberrations. Interchangeable aperture stop elements allow us to simulate perfect JWST wavefronts for wavefront error testing, or introduce transmissive phase plates to simulate a misaligned JWST segmented mirror for wavefront sensing verification. NOTES will be maintained at an operating temperature of 80K during testing using thermal switches, allowing it to operate within the same test chamber as the NIRCam instrument. We discuss NOTES' current design status and on-going development activities.

Author

James Webb Space Telescope; Imaging Techniques; Cameras; Apertures; Wave Fronts; Simulators; Segmented Mirrors; Field of View

20070032647 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Space Infrared Interferometric Telescope (SPIRIT): Optical System Design Considerations

Wilson, Mark E.; Leisawitz, David; Martino, Anthony J.; Budinoff, Jason; Quijada, Manuel; Hyde, Tupper; August 26, 2007; 1 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San Diego, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

SPIRIT is a candidate NASA Origins Probe mission. It is a spatial and spectral interferometer operating at 4 K with an operating wavelength range 25 - 400 microns. This paper describes the various components of the candidate optical system, including telescopes, pointing and tracking optics, along with their functions. Some of the tradeoffs involved in selecting various components, with their particular characteristics, are described.

Author

Infrared Telescopes; Optical Equipment; Spaceborne Telescopes; Tracking (Position); Design Analysis

20070032675 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Telescope Wavefront Aberration Compensation with a Deformable Mirror in an Adaptive Optics System

Hemmati, Hamid; Chen, Yijiang; Crossfield, Ian; January 2005; 4 pp.; In English; Photonics West, Jan. 2005, San Jose, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40219

With the goal of reducing the surface wavefront error of low-cost multi-meter-diameter mirrors from about 10 waves peak-to-valley (P-V), at lpm wavelength, to approximately 1-wave or less, we describe a method to compensate for slowly varying wavefront aberrations of telescope mirrors. A deformable mirror is utilized in an active optical compensation system. The kMS wavefront error of a 0.3m telescope improved to 0.05 waves (0.26 waves P-V) from the original value of 1.4 waves RMS (6.5 waves P-V), measured at 633nm, and the Strehl ratio improved to 89% from the original value of 0.08%.

Author

Wave Fronts; Adaptive Optics; Deformable Mirrors; Aberration; Telescopes

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PLASMA PHYSICS

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

20070032043 NASA Marshall Space Flight Center, Huntsville, AL, USA
Development of Numerical Tools for the Investigation of Plasma Detachment from Magnetic Nozzles
Sankaran, Kamesh; Polzin, Kurt A.; June 25, 2007; 8 pp.; In English; 38th AIAA Plasma Dynamics and Lasers Conference, 25-28 Jun. 2007, Miami, FL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): SAA8-05968; Copyright; Avail.: CASI: A02, Hardcopy

A multidimensional numerical simulation framework aimed at investigating the process of plasma detachment from a magnetic nozzle is introduced. An existing numerical code based on a magnetohydrodynamic formulation of the plasma flow equations that accounts for various dispersive and dissipative processes in plasmas was significantly enhanced to allow for the modeling of axisymmetric domains containing three.dimensiunai momentum and magnetic flux vectors. A separate magnetostatic solver was used to simulate the applied magnetic field topologies found in various nozzle experiments. Numerical results from a magnetic diffusion test problem in which all three components of the magnetic field were present exhibit excellent quantitative agreement with the analytical solution, and the lack of numerical instabilities due to fluctuations in the value of del(raised dot)B indicate that the conservative MHD framework with dissipative effects is well-suited for multi-dimensional analysis of magnetic nozzles. Further studies will focus on modeling literature experiments both for the purpose of code validation and to extract physical insight regarding the mechanisms driving detachment.
Author
Magnetic Nozzles; Numerical Analysis; Plasma Physics; Mathematical Models; Magnetohydrodynamic Flow; Plasma Diffusion; Simulation

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SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering*; and *36 Lasers and Masers*.

20070032046 NASA Marshall Space Flight Center, Huntsville, AL, USA
Energy Band Gap, Intrinsic Carrier Concentration and Fermi Level of CdTe Bulk Crystal between 304 K and 1067 K
Su, Ching-Hua; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

Optical transmission measurements were performed on CdTe bulk single crystal. It was found that when a sliced and polished CdTe wafer was used, a white film started to develop when the sample was heated above 530 K and the sample became opaque. Therefore, a bulk crystal of CdTe was first grown in the window area by physical vapor transport; the optical transmission was then measured and from which the energy band gap was derived between 304 and 1067 K. The band gaps of CdTe can be fit well as a function of temperature using the Varshini expression: Eg (e V) = 1.5860 - 5.9117xl0(exp -4) T(sup 2)/(T + 160). Using the band gap data, the high temperature electron-hole equilibrium was calculated numerically by assuming the Kane's conduction band structure and a heavy-hole parabolic valance band. The calculated intrinsic carrier concentrations agree well with the experimental data reported previously. The calculated intrinsic Fermi levels between 270 and 1200 K were also presented.
Author
Cadmium Tellurides; Carrier Density (Solid State); Energy Bands; Energy Gaps (Solid State); Single Crystals; Light Transmission

20070032649 NASA Marshall Space Flight Center, Huntsville, AL, USA
Crystal Growth and Characterization of CdTe Grown by Vertical Gradient Freeze
Su, Ching-Hua; Lehoczky, S. L.; Raghothamachar, B.; Dudley, M.; [2007]; 1 pp.; In English; Copyright; Avail.: Other Sources; Abstract Only

In this study, crystals of CdTe were grown from melts by the unseeded vertical gradient freeze method. The quality of grown crystal were studied by various characterization techniques including Synchrotron White Beam X-ray Topography (SWBXT), chemical analysis by glow discharge mass spectroscopy (GDMS), low temperature photoluminescence (PL), and Hall measurements. The SWBXT images from various angles show nearly strain-free grains, grains with inhomogeneous

strains, as well as twinning nucleated in the shoulder region of the boule. The GDMS chemical analysis shows the contamination of Ga at a level of 3900 ppb, atomic. The low temperature PL measurement exhibits the characteristic emissions of a Ga-doped sample. The Hall measurements show a resistivity of 1 x l0(exp 7) ohm-cm at room temperature to 3 x 10(exp 9) ohm-cm at 78K with the respective hole and electron concentration of 1.7 x 10(exp 9) cm(exp -3) and 3.9 x 10(exp 7) cm(exp -3) at room temperature.
Author
Cadmium Tellurides; Characterization; Crystal Growth; Freezing; Gradients

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*.

20070032044 NASA Marshall Space Flight Center, Huntsville, AL, USA
Research Infrastructure Challenges for Graduate Programs in STEM Disciplines at Minority Institutions
Aggarwal, M. D.; Lal, Ravi; Penn, Benjamin G.; June 24, 2007; 9 pp.; In English; 2007 American Society for Engineering Education Annual Conference and Exposition 'Riding the Wave to Excellence in Engineering Education, 24-27 Jun. 2007, Honolulu, HI, USA
Contract(s)/Grant(s): NNG06GC58A
Report No.(s): AC-2007-1157; Copyright; Avail.: CASI: A02, Hardcopy

It is much more challenging to perform experimental research functions at many minority institutions, because of lack of adequate research infrastructure. This is especially true if one wishes to initiate and implement masters and doctoral degree program in physics. In the present paper, an attempt is made to discuss the various hurdles encountered by the authors in the establishment of Master's and Doctoral degree programs in physics at one of the HBCUs (Historically Black Colleges and Universities). The department got no special or necessary treatment and faculty members are asked to teach as much course work as any other undergraduate department on the campus. It was very hard to convince university administration that giving less teaching load to research producing department faculty, shall culminate in abundant funding for the future years. This scenario created an extra heavy pressure on the faculty to continue the program. Some of the challenges included the resistance of some faculty and administrators to change, lack of sufficient release time for research producing faculty, and potential variation in funding or support with changes in the state education budget proration or members of the administration. In spite of the indirect cost recovery, very little infrastructure facilities was provided and the federal funding agencies did not want to interfere in the administration of the university. Various issues of recruiting and mentoring minority students, retention in the STEM disciplines as well as research infrastructure challenges at an HBCU university are presented.
Author
Minorities; Education; Technologies; Engineering; Mathematics; Science; Research

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*.

20070031986 Science Applications International Corp., Honolulu, HI USA
Identity Management: Role Based Access Control for Enterprise Services
Kooker, Rick; Kane, Stephen; June 2004; 31 pp.; In English; 2004 Command and Control Research and Technology Symposium: The Power of Information Age Concepts and Technologies, 15-17 June 2004, San Diego, CA, USA; Original contains color illustrations
Report No.(s): AD-A466776; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA466776

The current Department of Defense (DoD) Network consists of separate domains, disparate networks that are geographically dispersed, and resourced by hundreds of diverse funding sources. As we move into a Network Centric DoD Enterprise and as Web and data services become available throughout the DoD Network with applications becoming Enterprise wide, an unreasonable burden will be placed on the service providers to research and gather the appropriate data

to determine if users requesting access should be authorized that access. A most challenging problem in managing large distributed systems is the complexity of security administration. Since most applications are not yet available as Web Services but rather still controlled within a certain localized command or enclave, the issue of authorization is manageable albeit error prone and expensive. DoD transformation to a Network Centric environment requires robust authentication of users and Web Services for C2 based on PKI/biometric technology and subsequent authorization/Access to data/services/applications provided by an Enterprise Role Based Access Control (ERBAC) system. This paper is designed to convey information to the audience of the importance, necessity, and urgency associated with the problem, the need to commit resources for a solution and subsequently working within that solution across the DoD enterprise.
Author
Access Control; Biometrics; Computer Information Security; Computer Security

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.

20070031930 NASA, Washington, DC, USA
NASA's Legacy of Technology Transfer and Prospects for Future Benefits
Comstock, Douglas A.; Lockney, Daniel; September 20, 2007; 10 pp.; In English; AIAA SPACE 2007 Conference and Exposition, 18-20 Sep. 2007, Long Beach, CA, USA
Report No.(s): AIAA Paper 2007-6283; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031930

Over the course of its history, NASA has nurtured partnerships with the private sector to facilitate the transfer of NASA-developed technologies. The benefits of these partnerships have reached throughout the economy and around the globe, as the resulting commercial products contributed to the development of services and technologies in the fields of health and medicine, transportation, public safety, consumer goods, environmental resources, computer technology, and industry. The National Aeronautics and Space Act of 1958 that created NASA called for the new agency to disseminate its technology for public benefit. More than 1,500 of the most compelling partnerships and innovations have been documented in NASA's Spinoff publication since 1976. Building on this dynamic history, NASA partnerships with the private sector continue to seek avenues by which technological achievements and innovations gleaned among the stars can be brought down to benefit our lives on Earth.
Author
Aerospace Technology Transfer; NASA Space Programs; Research and Development; Product Development; Information Dissemination

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*.

20070031773 NASA Marshall Space Flight Center, Huntsville, AL, USA
Testing in Support of Space Fission System Development and Qualification
Houts, Mike; Bragg-Sitton, Shannon; Garber, Anne; Godfrey, Tom; Martin, Jim; Pearson, Boise; Webster, Kenny; June 24, 2007; 34 pp.; In English; Space Nuclear Conference 2007, 24-28 June 2007, Boston, MA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031773

Extensive data would be required for the qualification of a fission surface power (FSP) system. The strategy for qualifying a FSP system could have a significant programmatic impact. This paper explores potential options that could be used for qualifying FSP systems, including cost-effective means for obtaining required data. three methods for obtaining qualification data are analysis, non-nuclear testing, and nuclear testing. It has been over 40 years since the US qualified a space reactor for launch. During that time, advances have been made related to all three methods. Perhaps the greatest advancement has occurred in the area of computational tools for design and analysis. Tools that have been developed, coupled with modem

computers, would have a significant impact on a FSP qualification. This would be especially true for systems with materials and fuels operating well within temperature, irradiation damage, and burnup limits. The ability to perform highly realistic non-nuclear testing has also advanced throughout the past four decades. Instrumented thermal simulators were developed during the 1970s and 1980s to assist in the development, operation, and assessment of terrestrial fission systems. Instrumented thermal simulators optimized for assisting in the development, operation, and assessment of modem FSP systems have been under development (and utilized) since 1998. These thermal simulators enable heat from fission to be closely mimicked (axial power profile, radial power profile, temperature, heat flux, etc.} and extensive data to be taken from the core region. Both steady-state and transient operation can be tested. For transient testing, reactivity feedback is calculated (or measured in cold/warm criticals) based on reactor temperature and/or dimensional changes. Pin power during a transient is then calculated based on the reactivity feedback that would occur given measured values of temperature and/or dimensional change. In this way nonnuclear testing can be used to provide very realistic information related to nuclear operation. Non-nuclear testing can be used at all levels, including component, subsystem, and integrated system testing. Realistic non-nuclear testing is most useful for systems operating within known temperature, irradiation damage, and burnup capabilities.
Author
Fission; Cost Effectiveness; Radiation Damage; Systems Engineering; Spacecraft Launching; Fuels; Design Analysis

20070031778 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Passive Thermal Compensation of the Optical Bench of the Galaxy Evolution Explorer
Ford, Virginia; Parks, Rick; Coleman, Michelle; August 2, 2004; 10 pp.; In English; 49th Annual SPIE International Symposium on Optical Science and Technology, 2-6 August 2004, Denver, CO, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40210

The Galaxy Evolution Explorer is an orbiting space telescope that will collect information on star formation by observing galaxies and stars in ultraviolet wavelengths. The optical bench supporting detectors and related optical components used an interesting and unusual passive thermal compensation technique to accommodate thermally-induced focal length changes in the optical system. The proposed paper will describe the optical bench thermal compensation design including concept, analysis, assembly and testing results.
Author
Optical Measuring Instruments; Ultraviolet Radiation; Spaceborne Telescopes; Optical Equipment; Temperature Effects; Star Formation; Design Analysis

20070031782 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Performance of the PARCS Testbed Cesium Fountain Frequency Standard
Enzer, Daphna G.; Klipstein, William M.; August 24, 2004; 13 pp.; In English; IEEE International Ultasound, Ferroelectrices and Frequency Control 50th Anniversary, 24-27 Aug. 2004, Montreal, Canada; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40207

A cesium fountain frequency standard has been developed as a ground testbed for the PARCS (Primary Atomic Reference Clock in Space) experiment, an experiment intended to fly on the International Space Station. We report on the performance of the fountain and describe some of the implementations motivated in large part by flight considerations, but of relevance for ground fountains. In particular, we report on a new technique for delivering cooling and trapping laser beams to the atom collection region, in which a given beam is recirculated three times effectively providing much more optical power than traditional configurations. Allan deviations down to 10<superscript -15> have been achieved with this method.
Author
Atomic Clocks; Cesium; Frequency Standards; International Space Station

20070031783 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Buffer Gas Experiments in Mercury (Hg+) Ion Clock
Chung, Sang K.; Prestage, John D.; Tjoelker, Robert L.; Maleki, Lute; August 23, 2004; 4 pp.; In English; IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society, 24 Aug. 2004, Montreal, Canada; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40206

We describe the results of the frequency shifts measured from various buffer gases that might be used as a buffer gas to

increase the loading efficiency and cooling of ions trapped in a small mercury ion clock. The small mass, volume and power requirement of space clock precludes the use of turbo pumps. Hence, a hermetically sealed vacuum system, incorporating a suitable getter material with a fixed amount of inert buffer gas may be a practical alternative to the groundbased system. The collision shifts of 40,507,347.996xx Hz clock transition for helium, neon and argon buffer gases were measured in the ambient earth magnetic field. In addition to the above non-getterable inert gases we also measured the frequency shifts due to getterable, molecular hydrogen and nitrogen gases which may be used as buffer gases when incorporated with a miniature ion pump. We also examined the frequency shift due to the low methane gas partial pressure in a fixed higher pressure neon buffer gas environment. Methane gas interacted with mercury ions in a peculiar way as to preserve the ion number but to relax the population difference in the two hyperfine clock states and thereby reducing the clock resonance signal. The same population relaxation was also observed for other molecular buffer gases (N<base 2> H<base 2>,) but at much reduced rate.
Author
Vacuum Systems; Molecular Gases; Mercury (Metal); Metal Ions; Gas Pressure; Atmospheric Ionization; Geomagnetism; Ion Pumps; Argon

20070031813 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
The Use of Liquid Isopropyl Alcohol and Hydrogen Peroxide Gas Plasma to Biologically Decontaminate Spacecraft Electronics
Bonner, J. K.; Tudryn, Carissa D.; Choi, Sun J.; Eulogio, Sebastian E.; Roberts, Timothy J.; Tudryn, Carissa D.; February 8, 2006; 7 pp.; In English; APEX 2006, 8-10 Feb. 2006, Anaheim, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40189

Legitimate concern exists regarding sending spacecraft and their associated hardware to solar system bodies where they could possibly contaminate the body's surface with terrestrial microorganisms. The NASA approved guidelines for sterilization as set forth in NPG 8020.12C, which is consistent with the biological contamination control objectives of the Committee on Space Research (COSPAR), recommends subjecting the spacecraft and its associated hardware to dry heat-a dry heat regimen that could potentially employ a temperature of 110(deg)C for up to 200 hours. Such a temperature exposure could prove detrimental to the spacecraft electronics. The stimulated growth of intermetallic compounds (IMCs) in metallic interconnects and/or thermal degradation of organic materials composing much of the hardware could take place over a prolonged temperature regimen. Such detrimental phenomena would almost certainly compromise the integrity and reliability of the electronics. Investigation of sterilization procedures in the medical field suggests that hydrogen peroxide (H202) gas plasma (HPGP) technology can effectively function as an alternative to heat sterilization, especially for heat-sensitive items. Treatment with isopropyl alcohol (IPA) in liquid form prior to exposure of the hardware to HPGP should also prove beneficial. Although IPA is not a sterilant, it is frequently used as a disinfectant because of its bactericidal properties. The use of IPA in electronics cleaning is widely recognized and has been utilized for many years with no adverse affects reported. In addition, IPA is the principal ingredient of the test fluid used in ionic contamination testers to assess the amount of ionic contamination found on the surfaces of printed wiring assemblies. This paper will set forth experimental data confirming the feasibility of the IPA/H202 approach to reach acceptable microbial reduction (MR) levels of spacecraft electronic hardware. In addition, a proposed process flow in which both IPA liquid and HPGP are utilized will be presented in Section 7.0.
Author
Contamination; Microorganisms; Sterilization; Thermal Degradation; Liquid Hydrogen; Hydrogen Peroxide; Biological Effects; Bactericides

20070031929 NASA, Washington, DC, USA
International Systems Integration on the International Space Station
Gerstenmaier, William H.; Ticker, Ronald L.; [2007]; 8 pp.; In English; International Astronautical Congress 2007, 24-28 Sep. 2007, Hyderabad, India; Original contains black and white illustrations
Report No.(s): IAC-07-B3.1.01; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031929

Over the next few months, the International Space Station (ISS), and human spaceflight in general, will undergo momentous change. The European Columbus and Japanese Kibo Laboratories will be added to the station joining U.S. and Russian elements already on orbit. Columbus, Jules Vernes Automated Transfer Vehicle (ATV) and Kibo Control Centers will soon be joining control centers in the US and Russia in coordinating ISS operations and research. The Canadian Special Purpose Dexterous Manipulator (SPDM) will be performing extra vehicular activities that previously only astronauts on EVA could do, but remotely and with increased safety. This paper will address the integration of these international elements and

operations into the ISS, both from hardware and human perspectives. Interoperability of on-orbit systems and ground control centers and their human operators from Europe, Japan, Canada, Russia and the U.S. pose significant and unique challenges. Coordination of logistical support and transportation of crews and cargo is also a major challenge. As we venture out into the cosmos and inhabit the Moon and other planets, it's the systems and operational experience and partnership development on ISS, humanity's orbiting outpost that is making these journeys possible.
Author
Systems Integration; International Space Station; European Space Agency; Manned Space Flight

20070031938 NASA Marshall Space Flight Center, Huntsville, AL, USA
Post-Flight Analysis of Selected Fluorocarbon and Other Thin Film Polymer Specimens Flown on MISSE-5
DeGroh, Kim; Finckenor, Miria; Minton, Tim; Brunsvold, Amy; Pippin, Gary; June 25, 2007; 23 pp.; In English; National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA; Original contains color illustrations
Contract(s)/Grant(s): 401769.06.03.07.02.02; Copyright; Avail.: CASI: A03, Hardcopy

Twenty thin film specimens were flown on M1SSE-5 as a cooperative effort between several organizations. This presentation will report results of initial inspections and post-flight measurements of the optical properties and recession of these materials due to the approx.13 month exposure period on the exterior of the International Space Station. These specimens were located on the 'anti-solar' side of the MISSE-5 container and received a low number of Equivalent Sun Hours of solar UV exposure. Profilometry and/or ATF measurements will be conducted to determine thickness changes and atomic oxygen-induced recession rates Six of the specimens were covered with thin Kapton films, 0.1 and 0.3 mil in thickness. The 0.1 mil Kapton was almost completely eroded, suggesting that the atomic oxygen fluence is <8 x 10(exp 19) atoms/sq cm, similar to levels experienced during Space Shuttle materials experiments in the 1980's and 1990's. A comparison of results from MISSE-5 and Space Shuttle experiments will be included for those materials common to both the short and long-term exposures.
Author
Thin Films; Optical Properties; Postflight Analysis; Inspection; Fluorocarbons

20070031940 NASA Marshall Space Flight Center, Huntsville, AL, USA
Analysis of Lunar Surface Charging for a Candidate Spacecraft Using NASCAP-2K
Parker, Linda; Minow, Joseph; Blackwell, William, Jr.; June 18, 2007; 11 pp.; In English; 10th Spacecraft Charging Technology Conference, 18-21 Jun. 2007, Biarritz, France; Original contains color illustrations
Contract(s)/Grant(s): NNM05AB50C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031940

The characterization of the electromagnetic interaction for a spacecraft in the lunar environment, and identification of viable charging mitigation strategies, is a critical lunar mission design task, as spacecraft charging has important implications both for science applications and for astronaut safety. To that end, we have performed surface charging calculations of a candidate lunar spacecraft for lunar orbiting and lunar landing missions. We construct a model of the spacecraft with candidate materials having appropriate electrical properties using Object Toolkit and perform the spacecraft charging analysis using Nascap-2k, the NASA/AFRL sponsored spacecraft charging analysis tool. We use nominal and atypical lunar environments appropriate for lunar orbiting and lunar landing missions to establish current collection of lunar ions and electrons. In addition, we include a geostationary orbit case to demonstrate a bounding example of extreme (negative) charging of a lunar spacecraft in the geostationary orbit environment. Results from the charging analysis demonstrate that minimal differential potentials (and resulting threat of electrostatic discharge) occur when the spacecraft is constructed entirely of conducting materials, as expected. We compare charging results to data taken during previous lunar orbiting or lunar flyby spacecraft missions.
Author
Spacecraft Charging; Lunar Surface; Mission Planning; Electromagnetic Interactions; Lunar Environment; Lunar Landing; Spacecraft Orbits

20070031961 NASA Marshall Space Flight Center, Huntsville, AL, USA
Optical Property Measurements on the Stardust Sample Return Capsule
Finckenor, Miria; June 25, 2007; 20 pp.; In English; National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031961

The Advanced Materials for Exploration (AME) task Materials Analysis of Returned Hardware from Stardust received

funding to perform non-destructive analyses of the non-primary science hardware components of the Stardust sample return capsule. These components were (a) the blunt body reentry heatshield, encased in Phenolic Impregnated Carbon Ablator (PICA); (b) the backshell of Super Lightweight Ablator 561 (SLA-561) material handpacked into phenolic Flexcore and coated with CV-1100 silicone; (c) the rope seal used in between the heatshield and backshell; (d) the internal multi-layer insulation (MLI) blankets; and (e) parts of the Kevlar straps left attached to the backshell. These components were analyzed to determine the materials' durability in the space environment. The goals of the task were (a) to determine how the various materials from which the components were built weathered the extreme temperatures and harsh space environment during the capsule's nearly 7-year voyage to and from its rendezvous with Comet Wild 2 and (b) to provide lessons-learned data for designers of future missions.
Author
Stardust Mission; Nondestructive Tests; Blunt Bodies; Ablative Materials; Aerospace Environments; Heat Shielding; Optical Properties

20070031962 NASA Marshall Space Flight Center, Huntsville, AL, USA
Validation of ISS Floating Potential Measurement Unit Electron Densities and Temperatures
Coffey, Victoria N.; Minow, Joseph I.; Parker, Linda N.; Bui, Them; Wright, Kenneth, Jr.; Koontz, Steven L.; Schneider, T.; Vaughn, J.; Craven, P.; June 18, 2007; 14 pp.; In English; 10th Spacecraft Charging and Technology Conference, 18-21 Jun. 2007, Biarritz, France; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Validation of the Floating Potential Measurement Unit (FPMU) electron density and temperature measurements is an important step in the process of evaluating International Space Station spacecraft charging issues .including vehicle arcing and hazards to crew during extravehicular activities. The highest potentials observed on Space Station are due to the combined VxB effects on a large spacecraft and the collection of ionospheric electron and ion currents by the 160 V US solar array modules. Ionospheric electron environments are needed for input to the ISS spacecraft charging models used to predict the severity and frequency of occurrence of ISS charging hazards. Validation of these charging models requires comparing their predictions with measured FPMU values. Of course, the FPMU measurements themselves must also be validated independently for use in manned flight safety work. This presentation compares electron density and temperatures derived from the FPMU Langmuir probes and Plasma Impedance Probe against the independent density and temperature measurements from ultraviolet imagers, ground based incoherent scatter radar, and ionosonde sites.
Author
Spacecraft Charging; Electron Energy; Temperature Measurement; International Space Station; Electrostatic Probes; Hazards; Aerospace Safety; Extravehicular Activity

20070031968 NASA Marshall Space Flight Center, Huntsville, AL, USA
Ellipsometric Analysis of Contaminant Layer on Optical Witness Samples from MISSE
Norwood, Joseph K.; June 25, 2007; 1 pp.; In English; 2007 National Space and Missile Materials Symposium MISSE Materials/Experiments General Dynamics Information Technology, 25-29 Jun. 2007, Keystone, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

Several optical witness samples included in the Materials for International Space Station Experiment (MISSE) trays have been analyzed with a variable angle spectroscopic ellipsometer or VASE. Witness samples of gold or platinum mirrors are extremely useful as collectors of space-borne contamination, due to the relative inertness of these noble metals in the atomic oxygen-rich environment of LEO. Highly accurate thickness measurements, typically at the sub-nanometer scale, may be achieved with this method, which uses polarized light in a spectral range of 300 to 1300 nanometers at several angles of incidence to the sample surface.
Author
Ellipsometry; Contaminants; Ellipsometers; Spectroscopy; International Space Station; Polarized Light

20070031995 NASA Marshall Space Flight Center, Huntsville, AL, USA
Space Vehicle Pose Estimation via Optical Correlation and Nonlinear Estimation
Rakoczy, John; Herren, Kenneth; [2007]; 14 pp.; In English; Defense and Security Symposium, 9-13 Apr. 2007, Orlando FL, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031995

A technique for 6-degree-of-freedom (6DOF) pose estimation of space vehicles is being developed. This technique draws upon recent developments in implementing optical correlation measurements in a nonlinear estimator, which relates the optical

correlation measurements to the pose states (orientation and position). For the optical correlator, the use of both conjugate filters and binary, phase-only filters in the design of synthetic discriminant function (SDF) filters is explored. A static neural network is trained a priori and used as the nonlinear estimator. New commercial animation and image rendering software is exploited to design the SDF filters and to generate a large filter set with which to train the neural network. The technique is applied to pose estimation for rendezvous and docking of free-flying spacecraft and to terrestrial surface mobility systems for NASA's Vision for Space Exploration. Quantitative pose estimation performance will be reported. Advantages and disadvantages of the implementation of this technique are discussed.
Author
Aerospace Vehicles; Nonlinearity; Estimating; Neural Nets; Optical Correlators

89
ASTRONOMY

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

20070031754 NASA Marshall Space Flight Center, Huntsville, AL, USA; Istanbul Univ., Turkey
Detailed Physical Modeling Reveals the Magnetar Nature of a Transient Anomalous X-ray Pulsar
Guever, T.; Oezel, F.; Goegues, E.; Kouveliotou, C.; [2007]; 10 pp.; In English; Copyright; Avail.: CASI: A02, Hardcopy

Anomalous X-ray Pulsars (AXPs) belong to a class of neutron stars believed to harbor the strongest magnetic fields in the universe, as indicated by their energetic bursts and their rapid spindowns. However, a direct measurement of their surface field strengths has not been made to date. It is also not known whether AXP outbursts result from changes in the neutron star magnetic field or crust properties. Here we report the first, spectroscopic measurement of the surface magnetic field strength of an AXP, XTE J1810-197, and solidify its magnetar nature. The field strength obtained from detailed spectral analysis and modeling is remarkably close to the value inferred from the rate of spindown of this source and remains nearly constant during numerous observations spanning over two orders of magnitude in source flux. The surface temperature, on the other hand, declines steadily and dramatically following the 2003 outburst of this source. Our findings demonstrate that heating occurs in the upper neutron star crust during an outburst and sheds light on the transient behaviour of AXPs.
Author
X Rays; Pulsars; Magnetars; Field Strength; Neutron Stars; Stellar Magnetic Fields; Magnetic Measurement

20070031815 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Daytime Use of Astronomical Telescopes for Deep-Space Optical Links
Roberts, W. Thomas; Ortiz, Gerard G.; Boyd, Tim A.; January 22, 2006; 10 pp.; In English; Free-Space Optical Communications, 22-25 Jan. 2006, San Jose, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40183

Tests at the 200-inch Hale Telescope on Palomar Mountain have demonstrated this telescope's ability to withstand considerable thermal stress, and subsequently produce remarkably unaffected results. During the day of June 29,2005, the Hale telescope dome was left open, and the telescope was exposed to outside air and direct sunlight for 8 hours. During this time, portions of the telescope structure in the telescope's optical path experienced temperature elevations of 30 C, while the primary mirror experienced unprecedented heating of over 3 C. The telescope's measured blind pointing accuracy after this exposure was not noticeably degraded from the measurements taken before exposure. More remarkably, the telescope consistently produced stellar images which were significantly better after exposure of the telescope (1.2 arcsec) than before (1.6 arcsec), even though the conditions of observation were similar. This data is the first step in co-opting astronomical telescopes for daytime use as astronomical receivers, and supports the contention that deleterious effects from daytime exposure of the telescope can be held to an acceptable level for interleaved communications and astronomy.
Author
Telescopes; Daytime; Astronomy; Optical Paths; Thermal Stresses; Deep Space; Accuracy

20070031881 NASA Marshall Space Flight Center, Huntsville, AL, USA

The Hinode(Solar-B)Mission: An Overview

Kosugi, T.; Matsuzaki, K.; Sakao, T.; Shimizu, T.; Sone, Y.; Tachikawa, S.; Minesugi, K.; Ohnishi, A.; Yamada, T.; Tsuneta, S.; Hara, H.; Ichimoto, K.; Suematsu, Y.; Shimojo, M.; Watanabe, T.; Shimada, S.; Davis, J. M.; Hill, L. D.; Owens, J. K.; Title, A. M.; Culhane, J. L.; Harra, L. K.; Doschek, G. A.; Golub, L.; [2007]; 15 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

The Hinode satellite (formerly Solar-B) of the Japan Aerospace Exploration Agency's Institute of Space and Astronautical Science (ISAS/JAXA) was successfully launched in September 2006. As the successor to the Yohkoh mission, it aims to understand how magnetic energy is transferred from the photosphere to the upper atmospheres and resulting in explosive energy releases. Hinode is an observatory style mission, with all the instruments being designed and built to work together to address the science aims. There are three instruments onboard: the Solar Optical Telescope (SOT), the EUV Imaging Spectrometer (EIS), and the X-ray Telescope (XRT). This paper overviews the mission, including the satellite, the scientific payload and operations. It will conclude with discussions on how the international science community can participate in the analysis of the mission data.

Author

Solar Optical Telescope; X Ray Telescopes; Extreme Ultraviolet Radiation; Imaging Spectrometers; Payloads

20070031884 NASA Marshall Space Flight Center, Huntsville, AL, USA

The Morphology of the X-ray Emission above 2 keV from Jupiter's Aurorae

Elsner, R.; Branduardi-Raymont, G.; Galand, M.; Grodent, D.; Waite, J. H.; Cravens, T.; Ford, P.; [2007]; 11 pp.; In English; Manetosphere of the Outer Planets, 25-29 Jun. 2007, San Antonio, TX, USA; Copyright; Avail.: CASI: A03, Hardcopy

The discovery in XMM-Newton X-ray data of X-ray emission above 2 keV from Jupiter's aurorae has led us to reexamine the Chandra ACIS-S observations taken in Feb 2003. Chandra's superior spatial resolution has revealed that the auroral X-rays with E > 2 keV are emitted from the periphery of the region emitting those with E < 1 keV. We are presently exploring the relationship of this morphology to that of the FUV emission from the main auroral oval and the polar cap. The low energy emission has previously been established as due to charge exchange between energetic precipitating ions of oxygen and either sulfur or carbon. It seems likely to us that the higher energy emission is due to precipitation of energetic electrons, possibly the same population of electrons responsible for the FUV emission. We discuss our analysis and interpretation.

Author

X Rays; Morphology; Jupiter (Planet); Emission; Auroras; Spatial Resolution

20070031939 NASA Marshall Space Flight Center, Huntsville, AL, USA

GRBs: The Most Distant Signposts in our Universe

Kouveliotou, Chryssa; June 19, 2007; 1 pp.; In English; The Danish Physical Society Annual Meeting, 19-20 Jun. 2007, Nyborg, Denmark; No Copyright; Avail.: Other Sources; Abstract Only

Gamma-Ray Bursts (GRBs) are the most powerful photon sources in the Universe, rivaled only by supernovae in the magnitude of their energy release. In 1997 GRB were found to originate in host galaxies at cosmological distances, revealing the total energy of their explosions to be an astounding approx.10(exp 52) - 10(exp 53)ergs. GRB durations span over five orders of magnitude, ranging from milliseconds to thousands of seconds. The underlying sources of the energy release remain, however, unknown. Leading candidates are mergers, either of two neutron stars or of a black hole and a neutron star, and core collapses of very massive stars, called 'collapsars'. To date the furthest GRB galaxy has been found at a cosmological redshift of 6.29, very close to the most distant quasar (at z=6.4). Since the Swift satellite continues to observe these phenomena at a rate of approx.120 per year, and with the upcoming launch of GLAST with two burst instruments on board, we will be able to use GRBs as beacons to probe very high redshifts. Thus bursts found at 6<z<20 can be efficient probes of the intergalactic medium, the first (population III) stars and the early stages of galaxy formation.

Author

Gamma Ray Bursts; Cosmology; Explosions; Massive Stars; Energy Sources; Neutron Stars; Black Holes (Astronomy)

20070031976 NASA Marshall Space Flight Center, Huntsville, AL, USA

First X-ray Observations of the Young Pulsar J1357-6429

Zavlin, Vyacheslav E.; [2007]; 15 pp.; In English; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031976

The first short Chandra and XMM-Newton observations of the young and energetic pulsar J1357-6429 provided strong

indications of a tail-like pulsar-wind nebula associated with this object, as well as strong pulsations of its X-ray flux with a pulsed fraction above 40% and a thermal component dominating at lower photon energies (below 2 keV). The elongated nebular is very compact in size. about 1' x 1.5' and might be interpreted as a pulsar jet. The thermal radiation is most plausibly emitted from the entire neutron star surface of an effective temperature about 1 MK covered with a magnetized hydrogen atmosphere At higher energies the pulsar's emission is of a nonthermal (magnetospheric) origin, with a power-law spectrum of a photon index Gamma approx. equals 1.1. This makes the X-ray properties of PSR J1357-6429 very similar to those of the youngest pulsars J1119-6127 and Vela with a detected thermal radiation.
Author
Pulsars; Neutron Stars; Emittance; Power Spectra; Thermal Radiation; X Rays

20070031983 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Picometer Level Modeling of a Shared Vertex Double Corner Cube in the Space Interferometry Mission Kite Testbed
Kuan, Gary M.; Dekens, Frank G.; May 24, 2006; 10 pp.; In English; Astonomical Telescopes and Instrumentation, Probing the Universe from Ground and Space, 24-31 May 2006, Orlando, FL, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40134

The Space Interferometry Mission (ESA) is a microarcsecond interferometric space telescope that requires picometer level precision measurements of its truss and interferometer baselines. Single-gauge metrology errors due to non-ideal physical characteristics of corner cubes reduce the angular measurement capability of the science instrument. Specifically, the non-common vertex error (NCVE) of a shared vertex, double corner cube introduces micrometer level single-gauge errors in addition to errors due to dihedral angles and reflection phase shifts. A modified ESA Kite Testbed containing an articulating double corner cube is modeled and the results are compared to the experimental testbed data. The results confirm modeling capability and viability of calibration techniques.
Author
Spaceborne Telescopes; Interferometry; Measuring Instruments; Metrology; Calibrating; Precision

20070031984 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA; California Inst. of Tech., Pasadena, CA, USA
Long Baseline Nulling Interferometry with the Keck Telescopes: A Progress Report
Mennesson, Bertrand; Akeson, R.; Appleby, E.; Bell, J.; Booth, A.; Colavita, M. M.; Crawford, S.; Creech-Eakman, M. J.; Dahl, W.; Fanson, J.; Felizardo, C.; Garcia, J.; Gathright, J.; Herstein, J.; Hovland, E.; Hrynevych, M.; Johansson, E.; Koresko, C.; Mignant, D. Le; Ligon, R.; Millan-Gabet, R.; Moore, J.; Neyman, C.; Palmer, D.; Panteleeva, T., et al.; October 3, 2005; 6 pp.; In English; Direct Imaging of Exoplanets: Science and Techniques, 3-7 Oct. 2005, Nice, France; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40199

The Keck Interferometer Nuller (KIN) is one of the major scientific and technical precursors to the Terrestrial Planet Finder Interferometer (TPF-I) mission. KIN's primary objective is to measure the level of exo-zodiacal mid-infrared emission around nearby main sequence stars, which requires deep broad-band nulling of astronomical sources of a few Janskys at 10 microns. A number of new capabilities are needed in order to reach that goal with the Keck telescopes: mid-infrared coherent recombination, interferometric operation in 'split pupil' mode, N-band optical path stabilization using K-band fringe tracking and internal metrology, and eventually, active atmospheric dispersion correction. We report here on the progress made implementing these new functionalities, and discuss the initial levels of extinction achieved on the sky.
Author
Astronomical Interferometry; Atmospheric Correction; Main Sequence Stars; Terrestrial Planets; Astronomy; Extinction; Metrology

20070032003 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Accessing Small Inner Working Angles with a Rotating Sub-Aperture Nuller
Serabyn, Eugene; Mennesso, B.; October 3, 2005; 6 pp.; In English; IAU Colloquium 200: Direct Imaaging of Exoplanets, Science and Techniques, 3-7 Oct. 2005, Villefranche-sur-mer, France; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40198

A new approach to high contrast observations near bright stars with a single-aperture telescope is discussed, which is

based on the idea of a rotating separated-aperture nulling interferometer. The approach can be described as a rotating sub-aperture nuller, because it nulls two or more sub-apertures within a single telescope's pupil, and uses baseline rotation to modulate the signals from off-axis sources in a manner similar to that of potential space-based nulling interferometers. The sub-aperture beams can be combined in a number of ways, including a fiber nuller and a rotational shearing interferometer. Such a rotating nulling coronagraph has two great advantages. First, it can be used on a ground-based telescope to test signal reconstruction approaches pertinent to potential space-based nulling interferometers. Moreover, it also has the potential to enable ground-based coronagraphic observations of faint off-axis companions very close to bright stars.
Author
Apertures; Interferometers; Ground Tests; Signal Processing; Telescopes

20070032035 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Space Infrared Interferometric Telescope (SPIRIT): Mission Study Results
Leisawitz, David; Baker, Charles; Barger, Amy; Benford, Dominic; Blain, Andrew; Boyle, Rob; Broderick, Richard; Budinoff, Jason; Carpenter John; Caverly, Richard; Chen, Phil; Cooley, Steve; Cottinhgam, Christine; Crooke, Julie; DiPietro, Dave; DiPirro, Mike; Femiano, Michael; Ferrer, Art; Fischer, Jackie; Gardner, Jonathan; Hallock, Lou; Harris, Kenny; Hartman, Kate; Harwit, Martin; Hillenbrand, Lyne; Spa Telescopes and Instrumentation I: Optical, Infrared, and Milimeter; Jul. 2006; Volume 6265, pp. 626540; In English; Original contains color illustrations
Report No.(s): AD-A468070; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1117/12.669820

We report results of a recently-completed pre-Formulation Phase study of SPIRIT, a candidate NASA Origins Probe mission. SPIRIT is a spatial and spectral interferometer with an operating wavelength range 25-400 micrometers. SPIRIT will provide sub-arcsecond resolution images and spectra with resolution R = 3000 in a 1 arcmin field of view to accomplish three primary scientific objectives: (1) Learn how planetary systems form from protostellar disks, and how they acquire their chemical organization; (2) Characterize the family of extrasolar planetary systems by imaging the structure in debris disks to understand how and where planets form, and why some planets are ice giants and others are rocky; and (3) Learn how high-redshift galaxies formed and merged to form the present-day population of galaxies. Observations with SPIRIT will be complementary to those of the James Webb Space Telescope and the ground-based Atacama Large Millimeter Array. All three observatories could be operational contemporaneously.
Author
Infrared Telescopes; Interferometry; Space Missions; Spaceborne Telescopes

20070032041 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Physical Nature of Polar Broad Absorption Line Quasars
Ghost, Kajal; Punsly, Brian; [2007]; 12 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

It has been shown based on radio variability arguments that some BALQSOs (broad absorption line quasars) are viewed along the polar axis (orthogonal to accretion disk) in the recent article of Zhou et a. These arguments are based on the brightness temperature, T(sub b) exceeding 10(exp 12) K which leads to the well-known inverse Compton catastrophe unless the radio jet is relativistic and is viewed along its axis. In this letter, we expand the Zhou et al sample of polar BALQSOs using their techniques applied to SDSS DR5. In the process, we clarify a mistake in their calculation of brightness temperature. The expanded sample of high T(sub b) BALQSOS, has an inordinately large fraction of LoBALQSOs (low ionization BALQSOs). We consider this an important clue to understanding the nature of the polar BALQSOs. This is expected in the polar BALQSO analytical/numerical models of Punsly that predicted that LoBALQSOs occur when the line of sight is very close to the polar axis, where the outflow density is the highest.
Author
Quasars; Radio Jets (Astronomy); Radio Astronomy

20070032047 NASA Marshall Space Flight Center, Huntsville, AL, USA
General Relativistic Radiative Transfer: Applications to Black-Hole Systems
Wu, Kinwah; Fuerst, Steven V.; Mizuno, Yosuke; Nishikawa, Ken-Ichi; Branduardi-Raymont, Graziella; Lee, Khee-Gan; [2007]; 12 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

We present general relativistic radiation transfer formulations which include opacity effects due to absorption, emission and scattering explicitly. We consider a moment expansions for the transfer in the presence of scattering. The formulation is

applied to calculation emissions from accretion and outflows in black-hole systems. Cases with thin accretion disks and accretion tori are considered. Effects, such as emission anisotropy, non-stationary flows and geometrical self-occultation are investigated. Polarisation transfer in curved space-time is discussed qualitatively.
Author
Black Holes (Astronomy); Radiative Transfer; Relativistic Effects; Active Galactic Nuclei

20070032095 NASA Goddard Space Flight Center, Greenbelt, MD, USA
High-Energy Emission from Rotation-Powered Pulsars
Harding, Alice K.; July 01, 2007; 1 pp.; In English; Astrophysics of Compact Objects, 1-7 Jul. 2007, Huangshan, China; No Copyright; Avail.: Other Sources; Abstract Only

Thirty-five years after the discovery of rotation-powered pulsars, we still do not understand their pulsed emission at any wavelength. In the last few years there have been some fundamental developments in acceleration and emission models. I will review both the basic physics of the models as well as the latest developments in understanding the high-energy emission of rotation-powered pulsars. Special and general relativistic effects play important roles in pulsar emission, from inertial frame-dragging near the stellar surface to aberration, time-of-flight and retardation of the magnetic field near the light cylinder. Understanding how these effects determine what we observe at different wavelengths is critical to unraveling the emission physics. Fortunately two new gamma-ray telescopes, AGILE and GLAST, with launches expected this year will detect many new gamma-ray pulsars and test the predictions of these models with unprecedented sensitivity and energy resolution for gamma-rays in the range of 30 MeV to 300 GeV.
Author
Gamma Rays; Stellar Rotation; Pulsars; Magnetic Fields; Relativistic Effects

20070032098 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Overview of Integration and Test of the James Webb Space Telescope Integrated Science Instrument Module
Drury, Michael; Becker, Neil; Bos, Brent; Davila, Pamela; Frey, Bradley; Hylan, Jason; Marsh, James; McGuffey, Douglas; Novak, Maria; Ohl, Raymond; Redman, Kevin; Sampler, Henry; Sullivan, Joseph; Walker, Ian; Wright, Geraldine; Young, Philip; [2007]; 1 pp.; In English; SPIE Conference, 26-30 Aug. 2007, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The James Webb Space Telescope (JWST) is a 6.6m diameter, segmented, deployable telescope for cryogenic IR space astronomy (approx.40K). The JWST Observatory architecture includes the Optical Telescope Element (OTE) and the Integrated Science Instrument Module (ISIM) element that contains four science instruments (SI) including a Guider. The SIs and Guider are mounted to a composite metering structure with outer dimensions of 2.1x2.2x1.9m. The SI and Guider units are integrated to the ISIM structure and optically tested at NASA/Goddard Space Flight Center as an instrument suite using a high-fidelity, cryogenic JWST telescope simulator that features a 1.5m diameter powered mirror. The SIs are integrated and aligned to the structure under ambient, clean room conditions. SI performance, including focus, pupil shear and wavefront error, is evaluated at the operating temperature. We present an overview of the ISIM integration within the context of Observatory-level construction. We describe the integration and verification plan for the ISIM element, including an overview of our incremental verification approach, ambient mechanical integration and test plans and optical alignment and cryogenic test plans. We describe key ground support equipment and facilities.
Author
James Webb Space Telescope; Measure and Integration; Cryogenics; Spaceborne Astronomy; Infrared Astronomy; Adaptive Optics; Systems Integration

20070032100 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Studying Galaxy Formation with the Hubble, Spitzer and James Webb Space Telescopes
Gardner, Jonathan P.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

The deepest optical to infrared observations of the universe include the Hubble Deep Fields, the Great Observatories Origins Deep Survey and the recent Hubble Ultra-Deep Field. Galaxies are seen in these surveys at redshifts 2x3, less than 1 Gyr after the Big Bang, at the end of a period when light from the galaxies has reionized Hydrogen in the inter-galactic medium. These observations, combined with theoretical understanding, indicate that the first stars and galaxies formed at z>lO, beyond the reach of the Hubble and Spitzer Space Telescopes. To observe the first galaxies, NASA is planning the James Webb Space Telescope (JWST), a large (6.5m), cold (<50K), infrared-optimized observatory to be launched early in the next decade into orbit around the second Earth- Sun Lagrange point. JWST will have four instruments: The Near-Infrared Camera,

the Near-Infrared multi-object Spectrograph, and the Tunable Filter Imager will cover the wavelength range 0.6 to 5 microns, while the Mid-Infrared Instrument will do both imaging and spectroscopy from 5 to 28.5 microns. In addition to JWST's ability to study the formation and evolution of galaxies, I will also briefly review its expected contributions to studies of the formation of stars and planetary systems.
Author
Galactic Evolution; James Webb Space Telescope; Spaceborne Telescopes; Visual Observation; Infrared Astronomy

20070032102 NASA Goddard Space Flight Center, Greenbelt, MD, USA
DESTINY, The Dark Energy Space Telescope
Pasquale, Bert A.; Woodruff, Robert A.; Benford, Dominic J.; Lauer, Tod; August 26, 2007; 1 pp.; In English; SPIE Optics and Photonics Conference, 26-30 Aug. 2007, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

We have proposed the development of a low-cost space telescope, Destiny, as a concept for the NASA/DOE Joint Dark Energy Mission. Destiny is a 1.65m space telescope, featuring a near-infrared (0.85-1.7m) survey camera/spectrometer with a moderate flat-field field of view (FOV). Destiny will probe the properties of dark energy by obtaining a Hubble diagram based on Type Ia supernovae and a large-scale mass power spectrum derived from weak lensing distortions of field galaxies as a function of redshift.
Author
Spaceborne Telescopes; Dark Energy; Near Infrared Radiation; Field of View

20070032104 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Scanning Hartmann Focus Test for the EUVI Telescopes aboard STEREO
Ohl, R.; Antonille, S.; Aronstein, D.; Dean, B.; Delmont, M.; Eichord, W.; Frey, B.; Kubalak, D.; Wilson, M.; Redman, K.; Hynes, S.; Shiri, R.; Smith, J. S.; Thompson, P.; 26 Aug. 2007; 2 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The Solar TErrestrial RElations Observatory (STEREO), the third mission in NASA s Solar Terrestrial Probes program, was launched in 2006 on a two year mission to study solar phenomena like coronal mass ejections. STEREO consists of two nearly identical satellites, each carrying a suite of instruments that provide, among other data, simultaneous images of the Sun. One of these telescopes is the Extreme Ultraviolet Instrument (EUVI). There are two EUVI telescopes, one on each STEREO satellite (EUVI-A and EUVI-B). EUVI is a normal incidence, 98mm diameter, Ritchey-Chretien telescope designed to obtain wide field of view (approx.1deg) images of the Sun at short wavelengths (approx.20nm) using a CCD detector. The telescope entrance aperture is divided into four quadrants by a mask near the secondary mirror spider veins. A mechanism that rotates another mask allows only one of these sub-apertures to accept light from the Sun during an observation. The EUVI is thus four co-aligned, off-axis telescopes. Each off-axis segment on the primary and secondary mirrors has a different extreme ultraviolet coating stack. Furthermore, the aperture select mechanism is synchronized with a filter wheel mechanism near the CCD detector. The EUVI contains no focus mechanism. Models predict that the difference in on-orbit operating temperature and ambient clean room conditions yield a 'best focus' difference between integration and operation of approx. 0.2mm.
Author
STEREO (Observatory); Telescopes; Field of View; Charge Coupled Devices; Solar Cosmic Rays; Solar Probes; Coronal Mass Ejection; Cassegrain Optics

20070032626 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Mass-Radius Relationships for Low-Mass Planets: From Iron Planets to Water Planets
Kuchner, Marc; June 25, 2007; 1 pp.; In English; Extreme Solar Systems, 25-29 Jun. 2007, San Torini, Greece; No Copyright; Avail.: Other Sources; Abstract Only

Transit observations, and radial velocity measurements, have begun to populate the mass radius diagram for extrasolar planets; fubture astrometric measurements and direct images promise more mass and radius information. Clearly, the bulk density of a planet indicates something about a planet s composition--but what? I will attempt to answer this question in general for low-mass planets (<Neptune mass) using a combination of analytic and numerical calculations, and I will show that all low-mass planets obey a kind of universal mass-radius relationship: an expansion whose first term is M approx. R(sup 3).
Author
Radial Velocity; Mass; Extrasolar Planets; Velocity Measurement; Astrometry

20070032628 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Space Infrared Interferometric Telescope (SPIRIT)

Rinehart, Stephen; May 16, 2007; 1 pp.; In English; Navigator Program Forum, 17-18 May 2007, Moffett Field, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Space Infrared Interferometric Telescope (SPIRIT) is a candidate NASA Origins Probe Mission. SPIRIT is a two-telescope Michelson interferometer covering wavelengths from 25-400 microns, providing simultaneously high spectral resolution and high angular resolution. With comparable sensitivity to Spitzer, but two orders of magnitude improvement in angular resolution, SPIRIT will enable us to address a wide array of compelling scientific questions, including how planetary systems form in disks and how new planets interact with the disk. Further, SPIRIT will lay the technological groundwork for an array of future interferometry missions with ambitious scientific goals, including the Terrestrial Planet Finder Interferometer/Darwin, and the Submillimeter Probe of the Evolution of Cosmic Structure.

Author

Spaceborne Telescopes; Michelson Interferometers; Infrared Telescopes; Planetary Systems; Spectral Resolution; High Resolution; Angular Resolution

20070032631 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Performance of the Anti-Coincidence Detector on the GLAST Large Area Telescope

Thompson, D. J.; Charles, E.; Hartman, R. C.; Moiseev, A. A.; Ormes, J. F.; AIP Conference Proceedings (The First GLAST Symposium); July 12, 2007; ISSN 0094-243X; Volume 921, pp. 588-589; In English; Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://dx.doi.org/10.1063/1.2757465

The Anti-Coincidence Detector (ACD), the outermost detector layer in the Gamma-ray Large Area Space Telescope (GLAST) Large Area Telescope (LAT), is designed to detect and veto incident cosmic ray charged particles, which outnumber cosmic gamma rays by 3-4 orders of magnitude. The challenge in ACD design is that it must have high (0.9997) detection efficiency for singly-charged relativistic particles, but must also have a low probability for self-veto of high-energy gammas by backplash radiation from interactions in the LAT calorimeter. Simulations and tests demonstrate that the ACD meete its design requirements. The performance of the ACD has remained stable thrugh stand-alone environmental testing, shipment across the U.S. installation onto the LAT, shipment back across the U.S., LAT environmental testing, and shipment to Arizona. As part of the fully-assembled GLAST observatory, the ACD is being readied for final testing before launch.

Author

Gamma Ray Telescopes; Anticoincidence Detectors; Systems Engineering; Spacecraft Performance; Structural Design

20070032650 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The James Webb Space Telescope

Nowak, Maria; Eichorn, William; Hill, Michael; Hylan, Jason; Marsh, James; Ohl, Raymond; Sampler, Henry; Wright, Geraldine; Crane, Allen; Herrera, Acey; Quigley, Robert; Jetten, Mark; Young, Philip; August 26, 2007; 2 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The James Webb Space Telescope (JWST) is a 6.6m diameter, segmented, deployable telescope for cryogenic IR space astronomy (approx.40K). The JWST Observatory architecture includes the Optical Telescope Element and the Integrated Science Instrument Module (ISIM) element that contains four science instruments (SI) including a Guider. The ISIM optical metering structure is a roughly 2.2x1.7x2.2mY, asymmetric frame that is composed of carbon fiber and resin tubes bonded to invar end fittings and composite gussets and clips. The structure supports the SIs, isolates the SIs from the OTE, and supports thermal and electrical subsystems. The structure is attached to the OTE structure via strut-like kinematic mounts. The ISM structure must meet its requirements at the approx.40K cryogenic operating temperature. The SIs are aligned to the structure s coordinate system under ambient, clean room conditions using laser tracker and theodolite metrology. The ISM structure is thermally cycled for stress relief and in order to measure temperature-induced mechanical, structural changes. These ambient-to-cryogenic changes in the alignment of SI and OTE-related interfaces are an important component in the JWST Observatory alignment plan and must be verified.

Author

James Webb Space Telescope; Infrared Astronomy; Metrology; Spaceborne Astronomy; Reference Stars

20070032653 NASA Goddard Space Flight Center, Greenbelt, MD, USA; Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Stellar Evolutionary Effects on the Abundance of PAHS and SN-Condensed Dust in Galaxies

Dwek, Eli; [2007]; 53 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): LTSA03-0000-065; Copyright; Avail.: CASI: A04, Hardcopy

Spectral aid photometric observations of nearby galaxies show a correlation between the strength of their mid-IR aromatic features and their metal abundance, and a deficiency of these features in low-metallicity galaxies. The aromatic features are most commonly attributed to emission from PAH molecules. In this paper, we suggest that the observed correlation represents a trend of PAH abundance with galactic age, reflecting the delayed injection of PAHs and carbon dust into the ISM, by AGB stars in their final, post-AGB phase of their evolution. These AGB stars are the primary sources of PAHs and carbon dust in galaxies, and recycle their ejecta back to the interstellar medium only after a few hundred million years of evolution on the main sequence. In contrast, more massive stars that explode as Type II supernovae inject their metals and dust almost instantaneously after their formation. After determining the PAH abundances in 35 nearby galaxies, we use a chemical evolution model to show that the delayed injection of carbon dust by AGB stars provides a natural explanation to the dependence of the PAH content, in galaxies with metallicity. We also show that larger dust particles giving rise to the far-IR emission follow a distinct evolutionary trend closely related to the injection of dust by massive stars into the ISM.

Author

Interstellar Matter; Stellar Evolution; Polycyclic Aromatic Hydrocarbons; Main Sequence Stars; Chemical Evolution; Cosmic Dust; Massive Stars; Far Infrared Radiation

20070032654 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Taking the Measure of the Universe: Cosmology from the WMAP Mission

Hinshaw, Gary F.; Mar. 26, 2007; 1 pp.; In English; Invited talk on WMAP at the OUtstanding Questions for the Standard Cosmological Model, 26-29 Mar. 2007, London, UK; No Copyright; Avail.: Other Sources; Abstract Only

The data from the first three years of operation of the Wilkinson Microwave Anisotropy Probe (WMAP) satellite provide detailed full-sky maps of the cosmic microwave background temperature anisotropy and new full-sky maps of the polarization. Together, the data provide a wealth of cosmological information, including the age of the universe, the epoch when the first stars formed, and the overall composition of baryonic matter, dark matter, and dark energy. The results also provide constraints on the period of inflationary expansion in the very first moments of time. These and other aspects of the mission will be discussed.

Author

Microwave Anisotropy Probe; Cosmic Microwave Background Radiation; Cosmology; Dark Matter; Anisotropy

20070032669 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Study on the Station Keeping Maintenance for the TPF Mission

Gomez, Gerard; Lo, Martin W.; Masdemont, J. J.; August 7, 2005; 15 pp.; In English; AAS Astrodynamics Specialist Conference, 7-11 Aug. 2005, Lake Tahoe, CA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): CIRIT 2001SGR-70; CIRIT 2003XT-00021; BFM2003-09504

Report No.(s): AAS 05-424; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40216

The main goal of this paper is to extend the results of Gomez et al, 2001, related to the execution of the formation manoeuvres of the TPF constellation, including the controls for the station keeping and allowing a greater flexibility in the basic manoeuvres to be done by the formation.

Author

Extrasolar Planets; Stationkeeping; Formation Flying; Planetary Systems; Light Sources; High Resolution; Constellations; Diffraction Patterns

90
ASTROPHYSICS

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

20070031774 NASA Marshall Space Flight Center, Huntsville, AL, USA
All-Sky Hard X-Ray Spectral Line Survey with EXIST
Fishman, G. J.; Grindlay, J. E.; Hong, J.; Hartmann, D. H.; Vadawale, S.; Wilson-Hodge, C. A.; New Astronomy Reviews; October 2006; ISSN 1387-6473; Volume 50, pp. 637-639; In English; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1016/j.newar.2006.06.059

The Energetic X-ray Imaging Survey Telescope (EXIST), under study to be the Black Hole Finder Probe in NASA's Beyond Einstein Program, would image the sky every 95 min in the energy range 10-600 keV. Although the main scientific objectives of EXIST are the systematic, all-sky survey of heavily obscured AGNs and gamma-ray bursts, there is a substantial capability of EXIST for the observation of transient and persistent hard X-ray lines from several astrophysical sources.
Author
Line Spectra; X Ray Imagery; Astrophysics; Gamma Ray Bursts; Black Holes (Astronomy)

20070031867 NASA Marshall Space Flight Center, Huntsville, AL, USA
Using a Magnetic Flux Transport Model to Predict the Solar Cycle
Lyatskaya, S.; Hathaway, D.; Winebarger, A.; May 27, 2007; 1 pp.; In English; 210th American Astronomical Society Meeting, 27-31 May 2007, Honolulu, HI, USA; Copyright; Avail.: Other Sources; Abstract Only

We present the results of an investigation into the use of a magnetic flux transport model to predict the amplitude of future solar cycles. Recently Dikpati, de Toma, & Gilman (2006) showed how their dynamo model could be used to accurately predict the amplitudes of the last eight solar cycles and offered a prediction for the next solar cycle - a large amplitude cycle. Cameron & Schussler (2007) found that they could reproduce this predictive skill with a simple 1-dimensional surface flux transport model - provided they used the same parameters and data as Dikpati, de Toma, & Gilman. However, when they tried incorporating the data in what they argued was a more realistic manner, they found that the predictive skill dropped dramatically. We have written our own code for examining this problem and have incorporated updated and corrected data for the source terms - the emergence of magnetic flux in active regions. We present both the model itself and our results from it - in particular our tests of its effectiveness at predicting solar cycles.
Author
Magnetic Flux; Predictions; Solar Cycles; Transport Properties

20070031876 NASA Marshall Space Flight Center, Huntsville, AL, USA
GRMHD/RMHD Simulations and Stability of Magnetized Spine-Sheath Relativistic Jets
Hardee, Philip; Mizuno, Yosuke; Nishikawa, Ken-Ichi; [2007]; 5 pp.; In English
Contract(s)/Grant(s): NCC8-256; NSF AST-05-06666; NNG05GK73G; HST-AR-10966.01-A; NSF AST-05-06719; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031876

A new general relativistic magnetohydrodynamics (GRMHD) code 'RAISHIN' used to simulate jet generation by rotating and non-rotating black holes with a geometrically thin Keplarian accretion disk finds that the jet develops a spine-sheath structure in the rotating black hole case. Spine-sheath structure and strong magnetic fields significantly modify the Kelvin-Helmholtz (KH) velocity shear driven instability. The RAISHIN code has been used in its relativistic magnetohydrodynamic (RMHD) configuration to study the effects of strong magnetic fields and weakly relativistic sheath motion, cl2, on the KH instability associated with a relativistic, Y = 2.5, jet spine-sheath interaction. In the simulations sound speeds up to ? c/3 and Alfven wave speeds up to ? 0.56 c are considered. Numerical simulation results are compared to theoretical predictions from a new normal mode analysis of the RMHD equations. Increased stability of a weakly magnetized system resulting from c/2 sheath speeds and stabilization of a strongly magnetized system resulting from d 2 sheath speeds is found.
Author
Magnetohydrodynamics; Kelvin-Helmholtz Instability; Accretion Disks; Magnetic Effects; Magnetohydrodynamic Waves; Black Holes (Astronomy)

20070031973 NASA Marshall Space Flight Center, Huntsville, AL, USA
Algorithms for Lunar Flash Video Search, Measurement, and Archiving
Swift, Wesley; Suggs, Robert; Cooke, William; June 11, 2007; 12 pp.; In English; Meteoroids 2007 Conference, 11-15 Jun. 2007, Barcelona, Spain; Original contains black and white illustrations
Contract(s)/Grant(s): NNM05AB50C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031973

Lunar meteoroid impact flashes provide a method to estimate the flux of the large meteoroid flux and thus their hazard to spacecraft. Although meteoroid impacts on the Moon have been detected using video methods for over a decade, the difficulty of manually searching hours of video for the rare, extremely brief impact flashes has discouraged the technique's systematic implementation. A prototype has been developed for the purpose of automatically searching Lunar video records for impact flashes, eliminating false detections, editing the returned possible flashes, and archiving and documenting the results. The theory and organization of the program is discussed with emphasis on the filtering out of several classes of false detections and retaining the brief portions of the raw video necessary for in depth analysis of the flashes detected. Several utilities for measurement, analysis, and location of the flashes on the moon included in the program are demonstrated. Application of the program to a year's worth of Lunar observations is discussed along with examples of impact flashes as well as several classes of false impact flashes.
Author
Algorithms; Meteorite Collisions; Hypervelocity Impact; Meteoroid Concentration

20070031980 NASA Marshall Space Flight Center, Huntsville, AL, USA
Detection of GRB 060927 at zeta = 5.47: Implications for the Use of Gamma-Ray Bursts as Probes of the End of the Dark Ages
Ruiz-Velasco, A. E.; Swan, H.; Troja, E.; Malesani, D.; Fynbo, J. P. U.; Sterling, R. L. C.; Xu, D.; Aharonian, F.; Akerlof, C.; Andersen, M. I.; Ashley, M. C. B.; Barthelmy, S. D.; Bersier, D.; CastroCeron, J. M.; Castro-Tirado, A. J.; Gehrels, N.; Gogus, E.; Gorosabel, J.; Guidorzi, C.; Guver, T.; Hjorth, J.; Horns, D.; Huang, K. Y.; Jakobsson, P.; Jensen, B. L., et al.; [2007]; 28 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

We report on follow-up observations of the gamma-ray burst GRB 060927 using the robotic ROTSE-IIIa telescope and a suite of larger aperture groundbased telescopes. An optical afterglow was detected 20 s after the burst, the earliest rest-frame detection of optical emission from any GRB. Spectroscopy performed with the VLT about 13 hours after the trigger shows a continuum break at lambda approx. equals 8070 A, produced by neutral hydrogen absorption at zeta = 5.6. We also detect an absorption line at 8158 A which we interpret as Si II lambda 1260 at zeta = 5.467. Hence, GRB 060927 is the second most distant GRB with a spectroscopically measured redshift. The shape of the red wing of the spectral break can be fitted by a damped Ly(alpha) profile with a column density with log(N(sub HI)/sq cm) = 22.50 +/- 0.15. We discuss the implications of this work for the use of GRBs as probes of the end of the dark ages and draw three main conclusions: i) GRB afterglows originating from zeta greater than or approx. equal to 6 should be relatively easy to detect from the ground, but rapid near-infrared monitoring is necessary to ensure that they are found; ii) The presence of large H I column densities in some GRBs host galaxies at zeta > 5 makes the use of GRBs to probe the reionization epoch via spectroscopy of the red damping wing challenging; iii) GRBs appear crucial to locate typical star-forming galaxies at zeta > 5 and therefore the type of galaxies responsible for the reionization of the universe.
Author
Gamma Ray Bursts; Light Emission; Line Spectra; Afterglows; Red Shift

20070031985 NASA Marshall Space Flight Center, Huntsville, AL, USA
Observations of High-Redshift X-Ray Selected Clusters with the Sunyaev-Zel'dovich Array
Muchovej, Stephen; Carlstrom, John E.; Cartwright, John; Greer, Christopher; Hawkins, David; Hennessey, Ryan; Joy, Marshall; Lamb, James; Leitch, Erik M.; Loh, Michael; Miller, Amber D.; Mroczkowski, Tony; Pryke, Clem; Reddall, Ben; Runyan, Marcus; Sharp, Matthew; Woody, David; Oct. 4, 2006; 20 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NSF AST-00-96913; NSF AST-06-04982; NSF PHY-0114422; NSF AST-0507545; NSF AST-0507161
Report No.(s): astro-ph/0610115v1; Copyright; Avail.: CASI: A03, Hardcopy

We report measurements of the Sunyaev-Zel'dovich (SZ) effect in three high redshift (0.89 less than or equal to z less than or equal to 1.03), X-ray selected galaxy clusters. The observations were obtained at 30 GHz during the commissioning period of a new, eight-element interferometer - the Sunyaev-Zel'dovich Array (SZA) - built for dedicated SZ effect observations. The SZA observations are sensitive to angular scales larger than those subtended by the virial radii of the

clusters. Assuming isothermality and hydrostatic equilibrium for the intracluster medium, and gas-mass fractions consistent with those for clusters at moderate redshift, we calculate electron temperatures, gas masses, and total cluster masses from the SZ data. The SZ-derived masses, integrated approximately to the virial radii, are 1.9 (sup +0.5)(sub -0.4) x 10(exp 14) solar mass for Cl J1415.1+3612, 3.4 (sup +0.6)(sub -0.5) x 10(exp 14) solar mass for Cl J1429.0+4241 and 7.2 (sup +1.3)(sub -0.9) x 10(exp 14) solar mass for Cl J1226.9+3332. The SZ-derived quantities are in good agreement with the cluster properties derived from X-ray measurements.
Author
Galactic Clusters; Red Shift; Sunyaev-Zeldovich Effect; Interferometers; X Rays; Arrays

20070032000 NASA Marshall Space Flight Center, Huntsville, AL, USA
Gamma-Ray Burst Afterglows as Probes of Environment and Blastwave Physics II: The Distribution of p and Structure of the Circumburst Medium
Starling, R. L. C.; vanderHorst, A. J.; Rol, E.; Wijers, R. A. M. J.; Kouveliotou, C.; Wiersema, K.; Curran, P. A.; Weltevrede, P.; [2007]; 27 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): HPRN-CT-2002-00294; NWO-639.043.302; Copyright; Avail.: CASI: A03, Hardcopy

We constrain blastwave parameters and the circumburst media of a subsample of BeppoSAX Gamma-Ray Bursts. For this sample we derive the values of the injected electron energy distribution index, p, and the density structure index of the circumburst medium, k, from simultaneous spectral fits to their X-ray, optical and nIR afterglow data. The spectral fits have been done in count space and include the effects of metallicity, and are compared with the previously reported optical and X-ray temporal behaviour. Assuming the fireball model, we can find a mean value of p for the sample as a whole of 2.035. A statistical analysis Of the distribution demonstrates that the p values in this sample are inconsistent with a single universal value for p at the 3sigma level or greater. This approach provides us with a measured distribution of circumburst density structures rather than considering only the cases of k = 0 (homogeneous) and k = 2 (wind-like). We find five GRBs for which k can be well constrained, and in four of these cases the circumburst medium is clearly wind-like. The fifth source has a value of 0 less than or equal to k less than or equal to 1, consistent with a homogeneous circumburst medium.
Author
Afterglows; Gamma Ray Bursts; Mathematical Models; Radio Waves; Astrophysics

20070032071 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Cosmic Ray Mantle Visibility on Kuiper Belt Objects
Cooper, John F.; Hill, Matt E.; Richardson, J. D.; Sturner, S. J.; December 11, 2006; 2 pp.; In English; 2006 American Geophysical Union Conference Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

Optically red objects constitute the dynamically cold, old component of the Classical Kuiper Belt (40 - 47 AU) with heliocentric orbits of low eccentricity and inclination. The red colors likely arise from primordial mixed ices processed by irradiation to meters in surface depth over the past four billion years, since the time of giant planet migration and Kuiper Belt stirring, at relatively moderate dosages of 60 gigarads provided by galactic cosmic ray protons and heavier ions. The red cosmic ray mantle is uniformly visible on the cold classical objects beneath a minimally thin eroded layer of more neutrally colored material arising from cumulative effects of heliospheric particle irradiation. The radiation fluxes are lowest in the middle heliospheric region containing the Classical Kuiper Belt and increase from there both towards and away from the Sun. Despite increasing irradiation at various times of solar system history from increases in solar and interstellar ion fluxes, the red object region has apparently never reached sufficiently high dosage levels to neutralize in color the red mantle material. Erosion processes, including plasma sputtering and micrometeroid impacts, act continuously to reduce thickness of the upper neutral crust and expose the cosmic ray mantle. A deeper layer at tens of meters and more may consist of relatively unprocessed ices that can erupt to the surface by larger impacts or cryovolcanism and account for brighter surfaces of larger objects such as 2003 UB313. Surface colors among the Kuiper Belt and other icy objects of the outer solar system are then a function, assuming uniform primordial composition, of relative thickness for the three layers and of the resurfacing age dependent on the orbital and impact history of each object.
Author
Cosmic Rays; Kuiper Belt; Visibility; Gas Giant Planets; Planetary Mantles

20070032078 NASA Marshall Space Flight Center, Huntsville, AL, USA
Radio Sources Toward Galaxy Clusters at 30 GHz
Coble, K.; Bonamente, M.; Carlstrom, J. E.; Dawson, K.; Hasler, N.; Holzapfel, W.; Joy, M.; LaRoque, S.; Marrone, D. P.; Reese, E. D.; [2007]; 32 pp.; In English

Contract(s)/Grant(s): NAG5-7985; NSF PHY-01-14422; NSF AST-99-81546; NSF AST-02-28963; NSF AST-01-04465; Copyright; Avail.: CASI: A03, Hardcopy

Extra-galactic radio sources are a significant contaminant in cosmic microwave background and Sunyaev-Zeldovich effect experiments. Deep interferometric observations with the BIMA and OVRO arrays are used to characterize the spatial, spectral, and flux distributions of radio sources toward massive galaxy clusters at 28.5 GHz. We compute counts of mJy source fluxes from 89 fields centered on known massive galaxy clusters and 8 non-cluster fields. We find that source counts in the inner regions of the cluster fields (within 0.5 arcmin of the cluster center) are a factor of 8.9 (+4.2 to -3.8) times higher than counts in the outer regions of the cluster fields (radius greater than 0.5 arcmin). Counts in the outer regions of the cluster fields are in turn a factor of 3.3 (+4.1 -1.8) greater than those in the noncluster fields. Counts in the non-cluster fields are consistent with extrapolations from the results of other surveys. We compute spectral indices of mJy sources in cluster fields between 1.4 and 28.5 GHz and find a mean spectral index of al[ja = 0.66 with an rms dispersion of 0.36, where flux S varies as upsilon(sup -alpha). The distribution is skewed, with a median spectral index of 0.72 and 25th and 75th percentiles of 0.51 and 0.92, respectively. This is steeper than the spectral indices of stronger field sources measured by other surveys.
Author

Cosmic Microwave Background Radiation; Extragalactic Radio Sources; Galactic Clusters; Spectra; Radio Astronomy

20070032103 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Mission Studies for the Terrestrial Planet Finder - Occulter (TPF-O)

Heap, S.; Lindler, D.; Lo, A.; August 30, 2007; 1 pp.; In English; SPIE Optics and Photonics Conference, 26-30 Aug. 2007, San Diego, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The 2000 decadal survey committee recommended a planet-finding telescope (TPF) capable of detecting and characterizing terrestrial planets orbiting nearby stars and of carrying out 'revolutionary' astrophysics research. In response, we have carried out mission studies for TPF-O, a promising version of TPF that makes use of a 'regular' telescope plus a free-flying occulter that blocks light from the target star while leaving planet light unattenuated. Our mission studies include design reference missions to carry out both planetary and general-astrophysics research. We will report on the results of these studies and describe their implications for the flight system and ground system.
Author

Terrestrial Planets; Telescopes; Astrophysics; Periodic Variations; Surveys

20070032629 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Cosmic Messengers: Binary Black Holes and Gravitational Waves

Centrella, Joan; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

The final merger of two black holes releases a tremendous amount of energy, more than the combined light from all the stars in the visible universe. This energy is emitted in the form of gravitational waves, and observing these sources with gravitational wave detectors such as LISA requires that we know the pattern or fingerprint of the radiation emitted. Since black hole mergers take place in regions of extreme gravitational fields, we need to solve Einstein s equations of general relativity on a computer in order to calculate these wave patterns. For more than 30 years, scientists have tried to compute these wave patterns. However, their computer codes have been plagued by problems that caused them to crash. . This situation has changed dramatically in the past 2 years, with a series of amazing breakthroughs. This talk will take you on this quest for these gravitational wave patterns, showing how a spacetime is constructed on a computer to build a simulation laboratory for binary black hole mergers. We will focus on the recent advances that are revealing these waveforms, and the dramatic new potential for discoveries that arises when these sources will. be observed by LISA.
Author

Black Holes (Astronomy); Gravitational Waves; Space-Time Functions; Waveforms; Gravitational Fields

20070032660 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

A Massive Bipolar Outflow and a Dusty Torus with Large Grains in the Preplanetary Nebula IRAS 22036+5306

Sahai, Raghvendra; Young, K.; Patel, N. A.; Sanchez Contreras, C.; Morris, M.; The Astrophysical Journal; August 10, 2006; Volume 653, pp. 1241-1252; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): GO-09463.01; NSF 99-81546; 399.20.40.06; 399.20.00.08; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40226

We report high angular resolution (approx.1') CO J=3-2 interferometric mapping using the Submillimeter Array (SMA) of IRAS 22036+5306 (I22036), a bipolar preplanetary nebula (PPN) with knotty jets discovered in our HST snapshot survey

of young PPNs. In addition, we have obtained supporting lower resolution (approx.10') CO and 13CO J=1-0 observations with the Owens Valley Radio Observatory (OVRO) interferometer, as well as optical long-slit echelle spectra at the Palomar Observatory. The CO J=3-2 observations show the presence of a very fast (approx.220 km/s), highly collimated, massive (0.03 Solar Mass) bipolar outflow with a very large scalar momentum (about 10(exp 39) g cm/s), and the characteristic spatiokinematic structure of bow shocks at the tips of this outflow. The H(alpha) line shows an absorption feature blueshifted from the systemic velocity by approx.100 km/s, which most likely arises in neutral interface material between the fast outflow and the dense walls of the bipolar lobes at low latitudes. The fast outflow in I22036, as in most PPNs, cannot be driven by radiation pressure. We find an unresolved source of submillimeter (and millimeter-wave) continuum emission in I22036, implying a very substantial mass (0.02-0.04 Solar Mass) of large (radius > or approx.1 mm), cold (< or approx.50 K) dust grains associated with I22036's toroidal waist. We also find that the C-13/C-12 ratio in I22036 is very high (0.16), close to the maximum value achieved in equilibrium CNO nucleosynthesis (0.33). The combination of the high circumstellar mass (i.e., in the extended dust shell and the torus) and the high C-13/C-12 ratio in I22036 provides strong support for this object having evolved from a massive (> or approx.4 Solar Mass) progenitor in which hot-bottom-burning has occurred.
Author
Bipolarity; Toruses; Dust; Angular Resolution; High Resolution; Interferometry; Submillimeter Waves; Stellar Mass; Stellar Envelopes

20070032663 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Exponential Sum Absorption Coefficients of Phosphine from 2750 to 3550/cm for Application to Radiative Transfer Analyses on Jupiter and Saturn
Temma, T.; Baines, K. H.; Butler, R. A. H.; Brown, L. R.; Sagui, L.; Kleiner, I.; Journal of Geophysical Research; December 8, 2006; ISSN 0148-0227; Volume 111; 10 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40229; http://dx.doi.org/10.1029/2006JE002720

PH3 exponential sum k coefficients were computed between 2750 and 3550/cm (2.82-3.64 (microns), in view of future application to radiative transfer analyses of Jupiter and Saturn in a phosphine absorption band near 3 microns. The temperature and pressure of this data set cover the ranges from 80 to 350 K and from 10 (exp -3)to 10(exp 1) bars, respectively. Transmission uncertainty incurred by the use of the k coefficients is smaller than a few percent as long as the radiation is confined above an altitude of a few bars in the giant planets. In spectral regions of weak absorption at high pressures close to 10 bars, contributions from far wings of strong absorption lines must be carefully taken into account. Our data set helps map the three-dimensional distribution of PH3 on the giant planets, revealing their global atmospheric dynamics extending down to the deep interior. The complete k coefficient data set of this work is available at the Web site of the NASA Planetary Data System Atmospheres Node.
Author
Radiative Transfer; Phosphines; Jupiter (Planet); Coefficients; Atmospheric Physics; Planetary Atmospheres

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LUNAR AND PLANETARY SCIENCE AND EXPLORATION

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

20070031788 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
The Mars Exploration Rover Project
Cook, Richard A.; October 2, 2004; 7 pp.; In English; International Astronautical Congress, 2 Oct. 2004, Vancouver, British Columbia, Canada; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40202

The twin rovers of the Mars Exploration Rover Project successfully landed on the surface of Mars in January 2004, and initiated a highly successful science and exploration campaign. This marked the culmination of an unprecedented four-year effort to design, build, launch, and operate two of the most complex planetary spacecraft ever built. The project was started in the aftermath of the 1999 Mars mission failures, and was commissioned to take advantage of the highly advantageous 2003 opportunity. The development schedule from project start to launch was only 35 months, so schedule management was the most significant challenge facing the project. This problem was compounded when early assumptions about the extent of

design heritage from Mars Pathfinder proved to be flawed. The project derived a number of useful lessons learned in solving these challenges that can be applied to future missions.
Author
Mars Exploration; Rover Project; Mars Roving Vehicles; Interplanetary Spacecraft; Mars Missions

20070031814 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Exploring Europa with an RPS-Powered Orbiter Spacecraft
Abelson, Robert D.; Spilker, Thomas R.; Shirley, James H.; Green, Jacklyn R.; Smythe, William D.; March 4, 2006; 11 pp.; In English; IEEE Aerospace Conference, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40188

This paper describes a conceptual flagship-class Europa orbiter concept that was assumed to launch as early as 2012, arriving at Europa approximately 8 years later using inner solar system gravity assists to reach Jupiter. Jupiter's intense radiation environment limits the mission duration at Europa to 30 days for this study, though the duration is a result of multiple trades and is by no means fixed. The Europa Subgroup of the Outer Planets Assessment Group identified six primary science objectives for this concept.
Author
Europa; Spacecraft Trajectories; Launch Vehicles; Jupiter Atmosphere; Space Exploration; Temperature Control; Thermal Protection; Thermoelectric Generators

20070031840 NASA Johnson Space Center, Houston, TX, USA; University of Southern California, Los Angeles, CA, USA
Mission Assurance and Flight Safety of Manned Space Flight: Implications for Future Exploration of the Moon and Mars
Kezirian, M. T.; [2007]; 2 pp.; In English; Microsymposium on Comparative Planetology, 2-3 Oct. 2007, Moscow, Russia Contract(s)/Grant(s): JSC-6000132079; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031840

As NASA implements the nation's Vision for Space Exploration to return to the moon and travel to Mars, new considerations will be be given to the processes governing design and operations of manned spaceflight. New objectives bring new technical challenges; Safety will drive many of these decisions.
Derived from text
Manned Space Flight; Aerospace Safety; Interplanetary Flight; Lunar Programs; Risk; Aerospace Engineering

20070031841 LZ Technology, Inc., Houston, TX, USA
Determining Desirable Cursor Control Device Characteristics for NASA Exploration Missions
Sandor, Aniko; Holden, Kritina L.; [2007]; 4 pp.; In English; CHI 2008, 5 Apr. 2008, Florence, Italy; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

A test battery was developed for cursor control device evaluation: four tasks were taken from ISO 9241-9, and three from previous studies conducted at NASA. The tasks focused on basic movements such as pointing, clicking, and dragging. Four cursor control devices were evaluated with and without Extravehicular Activity (EVA) gloves to identify desirable cursor control device characteristics for NASA missions: 1) the Kensington Expert Mouse, 2) the Hulapoint mouse, 3) the Logitech Marble Mouse, and 4) the Honeywell trackball. Results showed that: 1) the test battery is an efficient tool for differentiating among input devices, 2) gloved operations were about 1 second slower and had at least 15% more errors; 3) devices used with gloves have to be larger, and should allow good hand positioning to counteract the lack of tactile feedback, 4) none of the devices, as designed, were ideal for operation with EVA gloves.
Author
NASA Programs; Control Equipment; Extravehicular Activity; Space Missions; Electric Batteries

20070031872 NASA Langley Research Center, Hampton, VA, USA
Lunar Lander Structural Design Studies at NASA Langley
Wu, K. Chauncey; Antol, Jeffrey; Watson, Judith J.; Flick, John J.; Saucillo, Rudolph J.; Mazanek, Daniel D.; North, David D.; September 18, 2007; 16 pp.; In English; AIAA Space 2007 Conference and Exposition, 18-20 September 2007, Long Beach, CA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031872

The National Aeronautics and Space Administration is currently developing mission architectures, vehicle concepts and

flight hardware to support the planned human return to the Moon. During Phase II of the 2006 Lunar Lander Preparatory Study, a team from the Langley Research Center was tasked with developing and refining two proposed Lander concepts. The Descent-Assisted, Split Habitat Lander concept uses a disposable braking stage to perform the lunar orbit insertion maneuver and most of the descent from lunar orbit to the surface. The second concept, the Cargo Star Horizontal Lander, carries ascent loads along its longitudinal axis, and is then rotated in flight so that its main engines (mounted perpendicular to the vehicle longitudinal axis) are correctly oriented for lunar orbit insertion and a horizontal landing. Both Landers have separate crew transport volumes and habitats for surface operations, and allow placement of large cargo elements very close to the lunar surface. As part of this study, lightweight, efficient structural configurations for these spacecraft were proposed and evaluated. Vehicle structural configurations were first developed, and preliminary structural sizing was then performed using finite element-based methods. Results of selected structural design and trade studies performed during this activity are presented and discussed.
Author
Structural Design; Lunar Landing; Ares 5 Cargo Launch Vehicle; NASA Space Programs; General Overviews; Manned Spacecraft

20070031874 American Inst. of Aeronautics and Astronautics, Reston, VA, USA
Imaginable Technologies for Human Missions to Mars
Aerospace America; June 2007; ISSN 0740-722X, pp. 24-30; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

Several technologies are available to allow the planning for human missions to Mars to progress. They must both be cost effective and safe. This article reviews several feasible technologies that must be developed to make the Vision for Space Exploration a reality. The technologies that this article reviews fall into the broad categories of Earth to Orbit access, in-space propulsion and power, and dry weight reductions.
CASI
Space Exploration; Interplanetary Flight; Interplanetary Spacecraft; Manned Mars Missions

20070031906 NASA Glenn Research Center, Cleveland, OH, USA
Aerosol Measurements of the Fine and Ultrafine Particle Content of Lunar Regolith
Greenberg, Paul S.; Chen, Da-Ren; Smith, Sally A.; September 2007; 20 pp.
Report No.(s): NASA/TM-2007-214956; E-16109-1; Copyright; Avail.: CASI: A03, Hardcopy

We report the first quantitative measurements of the ultrafine (20 to 100 nm) and fine (100 nm to 20 m) particulate components of Lunar surface regolith. The measurements were performed by gas-phase dispersal of the samples, and analysis using aerosol diagnostic techniques. This approach makes no a priori assumptions about the particle size distribution function as required by ensemble optical scattering methods, and is independent of refractive index and density. The method provides direct evaluation of effective transport diameters, in contrast to indirect scattering techniques or size information derived from two-dimensional projections of high magnification-images. The results demonstrate considerable populations in these size regimes. In light of the numerous difficulties attributed to dust exposure during the Apollo program, this outcome is of significant importance to the design of mitigation technologies for future Lunar exploration.
Author
Aerosols; Lunar Rocks; Regolith; Geophysics; Particulates; Lunar Surface; Lunar Exploration

20070031926 NASA Langley Research Center, Hampton, VA, USA
Hypervelocity Impact (HVI), Volume 8, Tile Small Targets A-1, Ag-1, B-1, and Bg-1
Gorman, Michael R.; Ziola, Steven M.; September 2007; 154 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NNL05AC19T; WBS 377816.06.03.03.06
Report No.(s): NASA/CR-2007-214885/VOL8; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031926

During 2003 and 2004, the Johnson Space Center's White Sands Testing Facility in Las Cruces, New Mexico conducted hypervelocity impact tests on the space shuttle wing leading edge. Hypervelocity impact tests were conducted to determine if Micro-Meteoroid/Orbital Debris impacts could be reliably detected and located using simple passive ultrasonic methods.

The objective of Targets A-1, Ag-1, B-1, and Bg-1 was to study hypervelocity impacts on the reinforced Shuttle Heat Shield Tiles of the Wing. Impact damage was detected using lightweight, low power instrumentation capable of being used in flight. Author

Hypervelocity Impact; Targets; Heat Shielding; Impact Tests; Leading Edges; Space Shuttles; Wings; Tiles

20070031950 NASA Johnson Space Center, Houston, TX, USA

Toxicity of Lunar and Martian Dust Simulants to Alveolar Macrophages Isolated from Human Volunteers

Latch, Judith N.; Hamilton, Raymond F., Jr.; Holian, Andrij; James, John T.; [2007]; 29 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NGT5-50084; MOI-RR-02558; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070031950

NASA is planning to build a habitat on the Moon and use the Moon as a stepping stone to Mars. JSC-1, an Arizona volcanic ash that has mineral properties similar to lunar soil, is used to produce lunar environments for instrument and equipment testing. NASA is concerned about potential health risks to workers exposed to these fine dusts in test facilities. The potential toxicity of JSC-1 and a Martian soil simulant (JSC-Mars-1, a Hawaiian volcanic ash) was evaluated using human alveolar macrophages (HAM) isolated from volunteers; titanium dioxide and quartz were used as reference dusts. This investigation is a prerequisite to studies of actual lunar dust. HAM were treated in vitro with these test dusts for 24 h; assays of cell viability and apoptosis showed that JSC-1 and TiO2 were comparable, and more toxic than saline control, but less toxic than quartz. HAM treated with JSC-1 or JSC-Mars 1 showed a dose-dependent increase in cytotoxicity. To elucidate the mechanism by which these dusts induce apoptosis, we investigated the involvement of the scavenger receptor (SR). Pretreatment of cells with polyinosinic acid, an SR blocker, significantly inhibited both apoptosis and necrosis. These results suggest HAM cytotoxicity may be initiated by interaction of the dust particles with SR. Besides being cytotoxic, silica is known to induce shifting of HAM phenotypes to an immune active status. The immunomodulatory effect of the simulants was investigated. Treatment of HAM with either simulant caused preferential damage to the suppressor macrophage subpopulation, leading to a net increase in the ratio of activator (RFD1+) to suppressor (RFD1+7+) macrophages, a result similar to treatment with silica. It is recommended that appropriate precautions be used to minimize exposure to these fine dusts in large-scale engineering applications.

Author

Habitats; Lunar Dust; Lunar Environment; Macrophages; Mars Surface; Toxicity

20070032004 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Mars Technology Program (MTP) Communications and Tracking Technologies for Mars Exploration

Antsos, Dimitrios; March 4, 2006; 20 pp.; In English; IEEE Aerospace Conference, Big Sky, Montana, March 4-11, 2006, 4-11 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations

Report No.(s): IEEEAC Paper 1247; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/40197; http://dx.doi.org/10.1109/AERO.2006.1655778

The MTP Communications and Tracking Technology Development Program aims to develop critical enabling technology components and products that will make the future high capacity communications links from Mars possible. It comprises ten technology development tasks. This paper briefly describes each task and gives a summary of the current state of the research and future recommendations.

Author

Mars Exploration; NASA Programs; Communication Networks; Telecommunication

20070032013 NASA Marshall Space Flight Center, Huntsville, AL, USA

The Challenges of Integrating NASA's Human, Budget, and Data Capital within the Constellation Program's Exploration Launch Projects Office

Kidd, Luanne; Morris, Kenneth B.; Self, Timothy A.; May 14, 2007; 2 pp.; In English; 54th JANNAF SPS Meeting, 14-17 May 2007, Denver, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

The U.S. Vision for Space Exploration directs NASA to retire the Space Shuttle in 2010 and replace it with safe, reliable, and cost-effective space transportation systems for crew and cargo travel to the Moon, Mars, and beyond. Such emerging space transportation initiatives face massive organizational challenges, including building and nurturing an experienced, dedicated team with the right skills for the required tasks; allocating and tracking the fiscal capital invested in achieving technical progress against an integrated master schedule; and turning generated data into useful knowledge that equips the team to

design and develop superior products for customers and stakeholders. It has been more than 30 years since the Space Shuttle was designed; therefore, the current aerospace workforce has limited experience with developing new designs for human-rated spaceflight hardware. To accomplish these activities, NASA is using a wide range of state-of-the-art information technology tools that connect its diverse, decentralized teams and provide timely, accurate information for decision makers. In addition, business professionals are assisting technical managers with planning, tracking, and forecasting resource use against an integrated master schedule that horizontally and vertically interlinks hardware elements and milestone events. Furthermore, NASA is employing a wide variety of strategies to ensure that it has the motivated and qualified staff it needs for the tasks ahead. This paper discusses how NASA's Exploration Launch Projects Office, which is responsible for delivering these new launch vehicles, integrates its resources to create an engineering business environment that promotes mission success, which is defined by replacing the Space Shuttle by 2014 and returning to the Moon by 2020.
Author
Launch Vehicles; Constellation Program; Moon; Budgeting; Mars (Planet); Space Transportation; Space Exploration

20070032021 Naval Observatory, Washington, DC USA
HST BVI Photometry of Triton and Proteus
Pascu, Dan; Storrs, Alex D.; Wells, Eddie N.; Hershey, John L.; Rohde, James R.; Seidelmann, P. K.; Currie, Douglas G.; Icarus; Sep. 15, 2006; ISSN 0019-1035; Volume 185, pp. 487-491; In English
Contract(s)/Grant(s): NAS5-26555
Report No.(s): AD-A467778; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1016/j.icarus.2006.07.020

BVI photometry of Triton and Proteus was derived from HST images taken in 1997. The VEGAMAG photometric technique was used. Triton was found to be brighter by a few percent than observations of the 1970's and 1980's, as expected due to the increasingly greater exposure of the bright south polar region. The leading side was also found to be brighter than the trailing side by 0.09 mag in all filters 50% larger than reported by Franz. Contrary to our previous results, we found no episodic reddening. Our previous conclusions were based on an inaccurate early version of the Charge Transfer Efficiency (CTE) correction. The present result limits the start of the reddening event reported by Hicks and Buratti. Our (B-V) result of 0.70 0.01 supports the global bluing described by Buratti et al. . Our observations of July 1997 agree with the Voyager results and are among the bluest colors seen. We found Proteus somewhat brighter than earlier studies, but in good agreement with the recent value given by Karkoschka. A leading/trailing brightness asymmetry was detected for Proteus, with the leading side 0.1 mag brighter. The unique differences in action of the endogenic and exogenic processes on Triton and Proteus provides an opportunity to separate the endogenic and exogenic effects on Triton.
Author
Astronomical Photometry; Proteus; Triton; Stellar Magnetospheres; Brightness

20070032058 NASA Glenn Research Center, Cleveland, OH, USA
Lithium Iron Phosphate Cell Performance Evaluations for Lunar Extravehicular Activities
Reid, COncha; August 23, 2007; 23 pp.; In English; 10th Electrochemical Power Sources Symposium, 20-23 Aug. 2007, Williamsburg, VA, USA
Contract(s)/Grant(s): WBS 038957.04.01.02.03.03; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032058

Lithium-ion battery cells are being evaluated for their ability to provide primary power and energy storage for NASA s future Exploration missions. These missions include the Orion Crew Exploration Vehicle, the Ares Crew Launch Vehicle Upper Stage, Extravehicular Activities (EVA, the advanced space suit), the Lunar Surface Ascent Module (LSAM), and the Lunar Precursor and Robotic Program (LPRP), among others. Each of these missions will have different battery requirements. Some missions may require high specific energy and high energy density, while others may require high specific power, wide operating temperature ranges, or a combination of several of these attributes. EVA is one type of mission that presents particular challenges for today s existing power sources. The Portable Life Support System (PLSS) for the advanced Lunar surface suit will be carried on an astronaut s back during eight hour long sorties, requiring a lightweight power source. Lunar sorties are also expected to occur during varying environmental conditions, requiring a power source that can operate over a wide range of temperatures. Concepts for Lunar EVAs include a primary power source for the PLSS that can recharge rapidly. A power source that can charge quickly could enable a lighter weight system that can be recharged while an astronaut is taking a short break. Preliminary results of Al23 Ml 26650 lithium iron phosphate cell performance evaluations for an advanced Lunar surface space suit application are discussed in this paper. These cells exhibit excellent recharge rate capability, however,

their specific energy and energy density is lower than typical lithium-ion cell chemistries. The cells were evaluated for their ability to provide primary power in a lightweight battery system while operating at multiple temperatures.
Author
Electric Batteries; Electrochemical Cells; Lithium; Metal Ions; Crew Exploration Vehicle; Extravehicular Activity; Life Support Systems; Energy Storage; Lunar Programs

20070032630 NASA Stennis Space Center, Stennis Space Center, MS, USA
Polar Lunar Regions: Exploiting Natural and Augmented Thermal Environments
Ryan, Robert E.; McKellip, Rodney; Brannon, David P.; Underwood, Lauren; Russell, Kristen J.; [2007]; 2 pp.; In English; AGU 2007 Winter Meeting, 10-14 Dec. 2007, San Francisco, CA, USA
Contract(s)/Grant(s): NNS04AB54T
Report No.(s): SSTI-2220-0121; Copyright; Avail.: Other Sources; Abstract Only

In polar regions of the Moon, some areas within craters are permanently shadowed from solar illumination and can reach temperatures of 100 K or less. These regions could serve as cold traps, capturing ice and other volatile compounds. These potential ice stores have many applications for lunar exploration. Within double-shaded craters, even colder regions exist, with temperatures never exceeding 50 K in many cases. Observed temperatures suggest that these regions could enable equivalent liquid nitrogen cryogenic functions. These permanently shaded polar craters also offer unprecedented high-vacuum cryogenic environments, which in their current state could support cryogenic applications. Besides ice stores, the unique conditions at the lunar poles harbor an environment that provides an opportunity to reduce the power, weight, and total mass that needs to be carried from the Earth to the Moon for lunar exploration and research. Reducing the heat flux of geothermal, black body radiation can have significant impacts on the achievable temperature. With a few manmade augmentations, permanently shaded craters located near the lunar poles achieve temperatures even lower than those that naturally exist. Our analysis reveals that lightweight thermal shielding within shaded craters could create an environment several Kelvin above absolute zero. The temperature ranges of both naturally shaded and thermally augmented craters could enable the long-term storage of most gases, low-temperature superconductors for large magnetic fields, devices and advanced high-speed computing instruments. Augmenting thermal conditions in these craters could then be used as a basis for the development of an advanced thermal management architecture that would support a wide variety of cryogenically based applications. Lunar exploration and habitation capabilities would significantly benefit if permanently shaded craters, augmented with thermal shielding, were used to facilitate the operation of near absolute zero instruments, including a wide variety of cryogenically based propulsion, energy, communication, sensing, and computing devices. The required burden of carrying massive life-supporting components from the Earth to the Moon for lunar exploration and research potentially could be reduced.
Author
Lunar Environment; Polar Regions; Thermal Environments; Moon; Augmentation

20070032644 NASA Marshall Space Flight Center, Huntsville, AL, USA
Quantitative Technique for Comparing Simulant Materials through Figures of Merit
Rickman, Doug; Hoelzer, Hans; Fourroux, Kathy; Owens, Charles; McLemore, Carole; Fikes, John; June 10, 2007; 36 pp.; In English; Planetary and Mining Science Symposium, 10-13 Jun. 2007, Sudbury, Ontario, Canada; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The 1989 workshop report entitled Workshop on Production and Uses of Simulated Lunar Materials and the Lunar Regolith Simulant Materials: Recommendations for Standardization, Production, and Usage, NASA Technical Publication both identified and reinforced a need for a set of standards and requirements for the production and usage of the Lunar simulant materials. As NASA prepares to return to the Moon, and set out to Mars, a set of early requirements have been developed for simulant materials and the initial methods to produce and measure those simulants have been defined. Addressed in the requirements document are: 1) a method for evaluating the quality of any simulant of a regolith, 2) the minimum characteristics for simulants of Lunar regolith, and 3) a method to produce simulants needed for NASA's Exploration mission. As an extension of the requirements document a method to evaluate new and current simulants has been rigorously defined through the mathematics of Figures of Merit (FoM). Requirements and techniques have been developed that allow the simulant provider to compare their product to a standard reference material through Figures of Merit. Standard reference material may be physical material such as the Apollo core samples or material properties predicted for any landing site. The simulant provider is not restricted to providing a single 'high fidelity' simulant, which may be costly to produce. The provider can now develop 'lower fidelity' simulants for engineering applications such as drilling and mobility applications.
Author
Figure of Merit; Lunar Composition; Computer Programs; Simulation

20070032680 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Radar Sounding of Mars: A Focus on MARSIS

Safaeinili, A.; Biccari, D.; Bombaci, O.; Gurnett, D.; Johnson, W. T. K.; Jordan, R. L.; Orosei, R.; Picardi, G.; Plaut, J.; Seu, R.; Zampolini, E.; Zelli, C.; August 6, 2001; 2 pp.; In English; Conference on the Geophysical Detection of Subsurface Water on Mars, 6-10 Aug. 2001, Houston, TX, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/12650

Radar has the unique capability of looking under the dry and cold surfaces of Mars. The depth of penetration of radio waves depends on a number of surface and subsurface parameters such as surface topography, subsurface geological structure and surface and subsurface electromagnetic properties. Among these parameters, the surface topography is known best largely due to valuable data provided by Mars Global Surveyor's MOLA instrument. However, little information is available on the electromagnetic properties and subsurface characteristics of Mars.

Derived from text

Radio Waves; Surface Properties; Electromagnetic Properties; Topography; Penetration; Geology

20070032685 NASA Marshall Space Flight Center, Huntsville, AL, USA

A Minimized Technological Approach towards Human Self Sufficiency off Earth

Curreri, Peter A.; [2007]; 7 pp.; In English; Space Technology and Applications International Forum (STAIF) Conference, 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070032685

Since the early 1970's it has been known that it is technically feasible to build large habitats in space where many people could live, more or less, independently off Earth. These large habitats would require decades of Apollo level expenditures to build. The objective of this paper is to begin the study of the minimum technological system that wi11 enable the historic shift from the state where all of humanity is dependent on Earth to the state where an independent human community can exist off Earth. It is suggested that such a system is more on the order of a homestead than a city. A minimum technical system is described that could support one human reproductive unit (family) in free space or on a planetary or lunar surface. The system consists of life support, materials extraction, mobility, and power production. Once the technology is developed for the single unit, many could be deployed. They could reproduce themselves at an exponential rate using space resources and energy. One would imagine cooperation of these units to build any combination of towns, cities and nations in space to extend human life beyond Earth.

Author

Extraterrestrial Resources; In Situ Resource Utilization; Planetary Bases; Space Habitats; Space Exploration

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SOLAR PHYSICS

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

20070031951 NASA Marshall Space Flight Center, Huntsville, AL, USA

SOHO-Ulysses Coordinated Studies During the Two Extended Quadratures and the Alignment of 2007-2008

Suess, S. T.; Poletto, G.; May 14, 2007; 1 pp.; In English; The International Heliosphere Year (IHY) Conference, 'Heliosphysics: the Sun, the Heliosphere, and the Earth', 14-19 May 2007, Bad Honnef, Germany; No Copyright; Avail.: Other Sources; Abstract Only

During SOHO-Sun-Ulysses quadratures the geometry of the configuration makes it possible to sample 'in situ' the plasma parcels that are remotely observed in the corona. Although the quadrature position occurs at a well defined instant in time, we typically take data while Ulysses is within +/- 5 degrees of the limb, with the understanding that plasma sampled by Ulysses over this time interval can all be traced to its source in the corona. The relative positions of SOHO and Ulysses in winter 2007 (19 Dec 2006-28 May 2007) are unusual: the SOHO-Sun-Ulysses included angle is always between 85 and 95 degrees - the quadrature lasts for 5 months! This provides an opportunity for extended observations of specific observing objectives. In addition, in summer 2007, Ulysses (at 1.34 AU) is in near-radial alignment with Earth/ACE/Wind and SOHO, allowing us to analyze radial gradients and propagation in the solar wind and inner heliosphere. Our own quadrature campaigns rely heavily on LASCO and UVCS coronal observations: LASCO giving the overall context above 2 solar radii while the UVCS spectrograph acquired data from - 1.5 to, typically, 4-5 solar radii. In the past, coronal parameters have been derived from data

acquired by these two experiments and compared with 'in situ' data of Ulysses' SWOOPS and SWICS. Data from other experiments like EIT, CDS, SUMER, Sac Peak Fe XIV maps, magnetic field maps from the Wilcox solar magnetograph, MLSO, from MDI, and from the Ulysses magnetograph experiment have been, and will be, used to complement LASCO/UVCS/SWOOPS and SWICS data. We anticipate that observations by ACE/WIND/STEREO/Hinode and other missions will be relevant as well. During the IHY campaigns, Ulysses will be 52-80 degrees south in winter 2007, near sunspot minimum. Hence, our own scientific objective will be to sample high speed wind or regions of transition between slow and fast wind. This might be a very interesting situation - not met in previous quadratures - allowing us to study the variation of element abundances across streamer borders in the corona and,correspondingly, 'in situ'. Also, observing plasma over prolonged time intervals and at different latitudes, we may examine the latitude variation of the fractionation effect (e.g. Yon Steiger, 2002) and its dependence on time (e.g. Woo, 2004). For instance, if the FIP bias is dictated by the duration of plasma confinement in solar loops, its value in streamers should depend on the streamer age. Analogous variations should be found in the abundances of 'in situ' plasma released by the streamer. All Ulysses and SOHO data is in the public domain and accessible so different objectives could be addressed by others. The winter 2008 quadrature will be well into the next sunspot cycle and there might be significant high mid-latitude activity. Ulysses will be up to 80 degrees in the northern hemisphere at this time and able to detect the resulting ICMEs and ejecta, allowing us to study the physical parameters of the propagating CME bubble/core/front, and/or to study the coronal and 'in situ' characteristics of the current sheet associated with the event (e.g. Bemporad et al. 2005), so far still vaguely defined.
Author
Alignment; Quadratures; Ulysses Mission; SOHO Mission; Annual Variations

20070031979 NASA Marshall Space Flight Center, Huntsville, AL, USA
New Evidence for the Role of Emerging Flux in a Solar Filament's Slow Rise Preceding its CME-Producing Fast Eruption
Sterling, Alphonse C.; Harra, Louis K.; Moore, Ronald L.; [2007]; 40 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

We observe the eruption of a large-scale (approx.300,000 km) quiet-region solar filament, leading to an Earth-directed 'halo' coronal mass ejection (CME). We use coronal imaging data in EUV from the EUV Imaging Telescope (EIT) on the Solar and Heliospheric Observatory (SOHO) satellite, and in soft X-rays (SXRs) from the Soft X-ray Telescope (SXT) on the Yohkoh satellite. We also use spectroscopic data from the Coronal Diagnostic Spectrometer (CDS), magnetic data from the Michelson Doppler Imager (MDI), and white-light coronal data from the Large Angle and Spectrometric Coronagraph Experiment (LASCO), all on SOHO. Initially the filament shows a slow (approx.1 km/s projected against the solar disk) and approximately constant-velocity rise for about 6 hours, before erupting rapidly, reaching a velocity of approx. 8 km/s over the next approx. 25 min. CDS Doppler data show Earth-directed filament velocities ranging from < 20 km/s (the noise limit) during the slow-rise phase, to approx. 100 km/s-1 early in the eruption. Beginning within 10 hours prior to the start of the slow rise, localized new magnetic flux emerged near one end of the filament. Near the start of and during the slow-rise phase, SXR microflaring occurred repeatedly at the flux-emergence site, in conjunction with the development of a fan of SXR illumination of the magnetic arcade over the filament. The SXR microflares, development of the SXR fan, and motion of the slow-rising filament are all consistent with 'tether-weakening' reconnection occurring between the newly-emerging flux and the overlying arcade field containing the filament field. The microflares and fan structure are not prominent in EUV, and would not have been detected without the SXR data. Standard 'twin dimmings' occur near the location of the filament, and 'remote dimmings' and 'brightenings' occur further removed from the filament.
Author
Coronal Mass Ejection; X Ray Telescopes; Imaging Techniques; Extreme Ultraviolet Radiation; Magnetic Flux; Magnetic Fields

20070031981 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Motion of 3-6 keV Nonthermal Sources Along the Legs of a Flare Loop
Sui, Linhui; Holman, Gordon D.; Dennis, Brian R.; [2007]; 12 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Observations of nonthermal X-ray sources me critical to studying electron acceleration and transport in solar flares. Strong thermal emission radiated from the preheated plasma before the flare impulsive phase often makes it difficult to detect low-energy X-ray sources that are produced by relatively low-energy nonthermal electrons. Knowledge of the distribution of these low-energy nonthermal electrons is particularly important in determining the total nonthermal electron energy in solar flares. We report on an 'early impulsive flare' in which impulsive hard X-ray emission was seen early in the flare before the

soft X-ray emission had risen significantly, indicating limited plasma pre-heating. Early in the flare, RHESSI < 25 keV images show coronal sources that moved first downward and then upwards along the legs of a flare loop. In particular, the 3-6 keV source appeared as a single coronal source at the start of the flare, and then it involved into two coronal sources moving down along the two legs of the loop. After nearly reaching the two footpoints at the hard X-ray peak, the two sources moved back up to the looptop again. RHESSI images and light curves all indicate that nonthermal emission dominated at energies as low as 3-6 keV. We suggest that the evolution of both the spectral index and the low-energy cutoff of the injected electron distribution could result in the accelerated electrons reaching a lower altitude along the legs of the dense flare loop and hence result in the observed downward and upward motions of the nonthermal sources.
Author
Thermal Emission; X Ray Sources; Plasma Heating; Solar Flares; Electron Energy; Electron Distribution; Electron Acceleration

20070031982 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Lecture on Thermal Radiation
Dennis, Brian R.; June 14, 2006; 1 pp.; In English; Summer Schools on High Energy Solar Physics, 14-23 Jun. 2006, Durham, NH, USA; No Copyright; Avail.: Other Sources; Abstract Only

This lecture will cover solar thermal radiation, particularly as it relates to the high energy solar processes that are the subject of this summer school. After a general review of thermal radiation from the Sun and a discussion of basic definitions, the various emission and absorption mechanisms will be described including black-body emission, bremsstrahlung, free-bound, and atomic line emissions of all kinds. The bulk of the time will be spent discussing the observational characteristics of thermal flare plasma and what can be learned about the flare energy release process from observations of the thermal radiation at all wavelengths. Information that has been learned about the morphology, temperature distribution, and composition of the flare plasma will be presented. The energetics of the thermal flare plasma will be discussed in relation to the nonthermal energy of the particles accelerated during the flare. This includes the total energy, the radiated and conductive cooling processes, and the total irradiated energy.
Author
Thermal Radiation; Solar Radiation; Temperature Distribution; Particle Energy; Thermal Plasmas

20070031994 NASA Marshall Space Flight Center, Huntsville, AL, USA
Updated Heliostorm Warning Mission: Enhancements Based on New Technology
Young, Roy M.; [2007]; 14 pp.; In English; 8th Gossamer Spacecraft Forum, 23-26 Apr. 2007, Honolulu, HI, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031994

The Heliostorm (also referred to as Geostorm) mission has been regarded as the best choice for the first application of solar sail technology. The objective of Heliostorm is to obtain data from an orbit station slightly displaced from the ecliptic at or nearer to the Sun than 0.98 AU, which places it twice as dose to the sun as Earth's natural L1 point at 0.993 AU. The maintenance of such an orbit location would require prohibitive amounts of propellants using chemical or electric propulsion systems; however, a solar sailcraft is ideally suited for this purpose because it relies solely on the propulsive force from photons for orbit maintenance. Heliostorm has been the subject of several mission studies over the past decade, with the most complete study conducted in 1999 in conjunction with a proposed New Millennium Program (NMP) Space Technology 5 (ST-5) flight opportunity. Recently, over a two and one-half year period dating from 2003 through 2005, NASA's In-Space Propulsion Technology Program (ISTP) matured solar sail technology from laboratory components to full systems, demonstrated in as relevant a space environment as could feasibly be simulated on the ground. Work under this program has yielded promising results for enhanced Heliostorm mission performance. This enhanced performance is achievable principally through reductions in the sail areal density. These reductions are realized through the use of lower linear mass density booms, a thinner sail membrane, and increased sail area. Advancements in sailcraft vehicle system design also offer potential mass reductions and hence improved performance. This paper will present the preliminary results of an updated Heliostorm mission design study including the enhancements incorporated during the design, development, analysis and testing of the system ground demonstrator.
Author
Solar Sails; Heliosphere; Sun; Technology Utilization; Space Missions; NASA Space Programs

20070032010 NASA Marshall Space Flight Center, Huntsville, AL, USA
SOHO-Ulysses Coordinated Studies During the Two Extended Quadratures and the Radial Alignment of 2007-2008
Suess, S. T.; Poletto, G.; May 14, 2007; 1 pp.; In English; The International Heliosphere Year (IHY) Conference 'Helophysics: the Sun, the Heliosphere, and the Earth', 14-19 May 2006, Bad Honnef, Germany; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

During quadrature, plasma seen on the limb of the Sun, along the radial direction to Ulysses, by SOHO or STEREO can be sampled in situ as lt later passes Ulysses. A figure shows a coronagraph image, the radial towards Ulysses at 58 deg. S. and the SOHO/UVCS slit positions during one set of observations. A CME subsequently occurred and passed Ulysses (at 3/4 AU) 15 days later.
Derived from text
Solar Wind; SOHO Mission; Ulysses Mission; Quadratures; Solar Activity

20070032070 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Virtual Solar Observatory and the Heliophysics Meta-Virtual Observatory
Gurman, Joseph B.; June 25, 2007; 1 pp.; In English; Solar Physics Division Meeting, 25-30 Jun. 2006, Durham, NH, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Virtual Solar Observatory (VSO) is now able to search for solar data ranging from the radio to gamma rays, obtained from space and groundbased observatories, from 26 sources at 12 data providers, and from 1915 to the present. The solar physics community can use a Web interface or an Application Programming Interface (API) that allows integrating VSO searches into other software, including other Web services. Over the next few years, this integration will be especially obvious as the NASA Heliophysics division sponsors the development of a heliophysics-wide virtual observatory (VO), based on existing VO's in heliospheric, magnetospheric, and ionospheric physics as well as the VSO. We examine some of the challenges and potential of such a 'meta-VO.'
Author
Heliosphere; Solar Observatories; Virtual Reality; Solar Physics

20070032072 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Solar Wind Excitation of Pc5 Fluctuations in the Magnetosphere and on the Ground
Kessel, Ramona L.; December 11, 2006; 1 pp.; In English; American Geophysical Union Conference, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The primary purpose of this paper is to show the strong link between solar wind compressional fluctuations in the 1-8 mHz frequency range and Pc5 fluctuations in the magnetosphere near the magnetopause, at geosynchronous orbit, over the poles, and on the ground. We focus on a time interval in March and April 2002 when there was a favorable alignment of satellites combined with ten high speed solar wind streams. We used the S3C Great Observatory: specifically, ACE and Wind in the solar wind, Geotail near the magnetopause, GOES 8 and 10 at geosynchronous orbit, Cluster over the poles, and CANOPUS/CARISMA ground stations near the footpoints of magnetic field lines connected to either the magnetopause or the GOES satellites. Using four examples and a statistical survey we show that magnetospheric Pc5 fluctuations exist regardless of IMF orientation and for a wide range of speeds and dynamic pressures; the amplitude and power of magnetospheric fluctuations depends primarily on the amplitude and power of solar wind dynamic pressure fluctuations. The driving and response frequency of these geoeffective fluctuations is in the range 0.5 - 4 mHz. The most striking magnetospheric response occurs when the solar wind speed, dynamic pressure, and dynamic pressure fluctuations all increase at approximately the same time, as frequently occurs near the leading edge of high speed streams. We show evidence of oscillating Poynting Flux at the magnetopause determined using Geotail data that both excites a FLR and propagates evanescently inward. These observations suggest that, at least for this time interval at spring equinox, the entry path is from the dayside equatorial magnetopause inward; multiple field line resonances may be excited from the magnetopause to geosynchronous orbit by propagating compressional waves, with the power decreasing inward away from the magnetopause.
Author
Excitation; Solar Wind; Earth Magnetosphere; Frequency Ranges; Geosynchronous Orbits; Ground Stations; Magnetopause

20070032074 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Variance of Solar Wind Magnetic Fluctuations: Solutions and Further Puzzles
Roberts, D. A.; Goldstein, M. L.; December 11, 2006; 1 pp.; In English; 2006 American Geophysical Union Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

We study the dependence of the variance directions of the magnetic field in the solar wind as a function of scale, radial

distance, and Alfvenicity. The study resolves the question of why different studies have arrived at widely differing values for the maximum to minimum power (approximately equal to 3:1 up to approximately equal to 20:1). This is due to the decreasing anisotropy with increasing time interval chosen for the variance, and is a direct result of the 'spherical polarization' of the waves which follows from the near constancy of |B|. The reason for the magnitude preserving evolution is still unresolved. Moreover, while the long-known tendency for the minimum variance to lie along the mean field also follows from this view (as shown by Barnes many years ago), there is no theory for why the minimum variance follows the field direction as the Parker angle changes. We show that this turning is quite generally true in Alfvenic regions over a wide range of heliocentric distances. The fact that nonAlfvenic regions, while still showing strong power anisotropies, tend to have a much broader range of angles between the minimum variance and the mean field makes it unlikely that the cause of the variance turning is to be found in a turbulence mechanism. There are no obvious alternative mechanisms, leaving us with another intriguing puzzle. Author

Solar Wind; Variance; Solar Magnetic Field; Magnetohydrodynamic Waves

20070032075 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Power Spectra, Power Law Exponents, and Anisotropy of Solar Wind Turbulence at Small Scales

Podesta, J. J.; Roberts, D. A.; Goldstein, M. L.; December 11, 2006; 1 pp.; In English; American Geophysical Union Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Wind spacecraft provides simultaneous solar wind velocity and magnetic field measurements with 3- second time resolution, roughly an order of magnitude faster than previous measurements, enabling the small scale features of solar wind turbulence to be studied in unprecedented detail. Almost the entire inertial range can now be explored (the inertial range extends from approximately 1 to 10(exp 3) seconds in the spacecraft frame) although the dissipation range of the velocity fluctuations is still out of reach. Improved measurements of solar wind turbulence spectra at 1 AU in the ecliptic plane are presented including spectra of the energy and cross-helicity, the magnetic and kinetic energies, the Alfven ratio, the normalized cross-helicity, and the Elsasser ratio. Some recent observations and theoretical challenges are discussed including the observation that the velocity and magnetic field spectra often show different power law exponents with values close to 3/2 and 5/3, respectively; the energy (kinetic plus magnetic) and cross-helicity often have approximately equal power law exponents with values intermediate between 3/2 and 5/3; and the Alfven ratio, the ratio of the kinetic to magnetic energy spectra, is often a slowly increasing function of frequency increasing from around 0.4 to 1 for frequencies in the inertial range. Differences between high- and low-speed wind are also discussed. Comparisons with phenomenological turbulence theories show that important aspects of the physics are yet unexplained.

Author

Anisotropy; Power Spectra; Solar Wind Velocity; Turbulence; Magnetohydrodynamic Waves

20070032084 NASA Marshall Space Flight Center, Huntsville, AL, USA

A Three-Dimensional MHD Simulation of the Solar Wind for a Tilted-Dipole Magnetic Field on the Sun

Goldstein, Melvyn L.; [2007]; 1 pp.; In English; The Second International Symposium on KuaFu Project (ISKP-II), 15-19 Jan. 2007, Sanya, China; Copyright; Avail.: Other Sources; Abstract Only

Using a three-dimensional MHD model, we simulate the global steady-state structure of the solar corona and solar wind for a dipole magnetic field on the Sun inclined by 30 degrees to the solar rotation axis. This represents the solar conditions typical for a declining phase of solar cycle. The computations can extend from the coronal base out to 100-AU and at large heliospheric distances includes the effects of interstellar neutral hydrogen and their interaction with solar wind protons. The simulations can model the formation of corotating interaction regions and the heliospheric current sheet. The simulations are also capable of describing very strong rarefaction regions that include embedded sub-Alfvenic regions that form on the trailing edge of a fast flows.

Author

Magnetohydrodynamics; Three Dimensional Models; Solar Wind; Magnetic Fields; Solar Activity; Solar Cycles

20070032105 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Evolution of Dust in Primordial Supernova Remnants: Can Dust Grains Formed in the Ejecta Survive and be Injected into the Early Interstellar Medium?

Nozawa, Takaya; Kozasa, Takashi; Habe, Asao; Dwek, Eli; [2007]; 34 pp.; In English

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We investigate the evolution of dust formed at Population III supernova (SN) explosions - its processing through the

collisions with the reverse shocks and its transport within SN remnants (SNRs) until approx.10(exp 5)-10(exp 6) yr - to reveal the chemical composition, size distribution, and amount of dust injected into the early interstellar medium (ISM). The results of calculations show that it takes 10(exp 3)-10(exp 4) years for the reverse shocks to encounter the dust condensed inside the He core because the progenitors retain the thick hydrogen envelopes. We demonstrate the segregated transport and destruction of dust grains within SNRs depending on their initial sizes a(sub ini); for Type II SNRs expanding into the ISM with the density of n(sub H,O) = 1/cu cm, small grains with a(sub ini) less than or approx. equal to 0.05 microns are completely destroyed by sputtering in the postshock flow, while the grains with a(sub ini) = 0.05-0.2 microns are trapped into the dense shell behind the forward shock. Very large grains of a(sub ini) greater than or approx. equal to 0.2 microns are ejected into the ISM without decreasing their sizes significantly. The resulting size distribution of survived dust is greatly deficient in small-sized grains, compared with that at the time of dust formation. The size below which dust is completely destroyed depends on the explosion energy of SNe and the gas density in the ISM, and the mass fraction of dust destroyed ranges from 0.2 to 1. We also discuss the effect of the hydrogen envelope on the evolution of dust in SNRs. Furthermore, referring to the results of calculations, we investigate the abundance patterns of the second-generation stars formed in the dense shell of primordial SNRs.

Author

Supernovae; Dust; Gas Evolution; Interstellar Matter; Population III Stars; Gas Density

20070032658 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Solar Cycle #24 and the Solar Dynamo

Pesnell, W. Dean; Schatten, Kenneth; September 24, 2007; 14 pp.; In English; 20th International Symposium on Space Flight Dynamics, 24-28 Sep. 2007, Annapolis, MD, USA; Original contains black and white illustrations

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ONLINE: http://hdl.handle.net/2060/20070032658

We focus on two solar aspects related to flight dynamics. These are the solar dynamo and long-term solar activity predictions. The nature of the solar dynamo is central to solar activity predictions, and these predictions are important for orbital planning of satellites in low earth orbit (LEO). The reason is that the solar ultraviolet (UV) and extreme ultraviolet (EUV) spectral irradiances inflate the upper atmospheric layers of the Earth, forming the thermosphere and exosphere through which these satellites orbit. Concerning the dynamo, we discuss some recent novel approaches towards its understanding. For solar predictions we concentrate on a solar precursor method, in which the Sun s polar field plays a major role in forecasting the next cycle s activity based upon the Babcock- Leighton dynamo. With a current low value for the Sun s polar field, this method predicts that solar cycle #24 will be one of the lowest in recent times, with smoothed F10.7 radio flux values peaking near 130+ 30 (2 4, in the 2013 timeframe. One may have to consider solar activity as far back as the early 20th century to find a cycle of comparable magnitude. Concomitant effects of low solar activity upon satellites in LEO will need to be considered, such as enhancements in orbital debris. Support for our prediction of a low solar cycle #24 is borne out by the lack of new cycle sunspots at least through the first half of 2007. Usually at the present epoch in the solar cycle (-7+ years after the last solar maximum), for a normal size following cycle, new cycle sunspots would be seen. The lack of their appearance at this time is only consistent with a low cycle #24. Polar field observations of a weak magnitude are consistent with unusual structures seen in the Sun s corona. Polar coronal holes are the hallmarks of the Sun s open field structures. At present, it appears that the polar coronal holes are relatively weak, and there have been many equatorial coronal holes. This appears consistent with a weakening polar field, but coronal hole data must be scrutinized carefully as observing techniques have changed. We also discuss new solar dynamo ideas, and the SODA (Solar Dynamo Amplitude) index, which provides the user with the ability to track the Sun s hidden, dynamo magnetic fields throughout the various stages of the Sun s cycle. Our solar dynamo ideas are a modernization and rejuvenation of the Babcock-Leighton original idea of a shallow solar dynamo, using modem observations that appear to support their shallow dynamo viewpoint. We are in awe of being able to see an object the size of the Sun undergoing as dramatic a change as our model provides in a few short years. The Sun, however, has undergone changes as rapid as this before! The weather on the Sun is at least as fickle as the weather on the Earth.

Author

Solar Cycles; Solar Activity; Extreme Ultraviolet Radiation; Low Earth Orbits; Dynamo Theory; Magnetic Fields; Coronal Holes; Solar Radiation

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SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

20070031942 NASA Johnson Space Center, Houston, TX, USA
Space Radiation Environmental Considerations for Commercial Space Flight
Johnson, Steve; Zapp, Neal; February 05, 2007; 16 pp.; In English; 10th Annual Commercial Space Transportation: Space Weather Issues and Tools, 5-7 Feb. 2007, Arlington, VA, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070031942

This viewgraph presentation reviews basic environmental information regarding solar energetic particle events and includes some discussion slides regarding the operational impacts application as it may apply to commercial spaceflight.
CASI
Energetic Particles; Extraterrestrial Radiation; Solar Corpuscular Radiation; Solar Flares; Solar Storms

20070032045 NASA Marshall Space Flight Center, Huntsville, AL, USA
High-Performance, Radiation-Hardened Electronics for Space Environments
Keys, Andrew S.; Watson, Michael D.; Frazier, Donald O.; Adams, James H.; Johnson, Michael A.; Kolawa, Elizabeth A.; June 25, 2007; 58 pp.; In English; International Planetary Probes Workshop-5, 25-29 Jun. 2007, Boudeaux, France; Original contains black and white illustrations; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070032045

The Radiation Hardened Electronics for Space Environments (RHESE) project endeavors to advance the current state-of-the-art in high-performance, radiation-hardened electronics and processors, ensuring successful performance of space systems required to operate within extreme radiation and temperature environments. Because RHESE is a project within the Exploration Technology Development Program (ETDP), RHESE's primary customers will be the human and robotic missions being developed by NASA's Exploration Systems Mission Directorate (ESMD) in partial fulfillment of the Vision for Space Exploration. Benefits are also anticipated for NASA's science missions to planetary and deep-space destinations. As a technology development effort, RHESE provides a broad-scoped, full spectrum of approaches to environmentally harden space electronics, including new materials, advanced design processes, reconfigurable hardware techniques, and software modeling of the radiation environment. The RHESE sub-project tasks are: SelfReconfigurable Electronics for Extreme Environments, Radiation Effects Predictive Modeling, Radiation Hardened Memory, Single Event Effects (SEE) Immune Reconfigurable Field Programmable Gate Array (FPGA) (SIRF), Radiation Hardening by Software, Radiation Hardened High Performance Processors (HPP), Reconfigurable Computing, Low Temperature Tolerant MEMS by Design, and Silicon-Germanium (SiGe) Integrated Electronics for Extreme Environments. These nine sub-project tasks are managed by technical leads as located across five different NASA field centers, including Ames Research Center, Goddard Space Flight Center, the Jet Propulsion Laboratory, Langley Research Center, and Marshall Space Flight Center. The overall RHESE integrated project management responsibility resides with NASA's Marshall Space Flight Center (MSFC). Initial technology development emphasis within RHESE focuses on the hardening of Field Programmable Gate Arrays (FPGA)s and Field Programmable Analog Arrays (FPAA)s for use in reconfigurable architectures. As these component/chip level technologies mature, the RHESE project emphasis shifts to focus on efforts encompassing total processor hardening techniques and board-level electronic reconfiguration techniques featuring spare and interface modularity. This phased approach to distributing emphasis between technology developments provides hardened FPGA/FPAAs for early mission infusion, then migrates to hardened, board-level, high speed processors with associated memory elements and high density storage for the longer duration missions encountered for Lunar Outpost and Mars Exploration occurring later in the Constellation schedule.
Author
Aerospace Environments; Aerospace Systems; Radiation Hardening; Electronics; Astrionics; Extraterrestrial Radiation

20070032087 NASA Goddard Space Flight Center, Greenbelt, MD, USA
VIIRS ZEMAX and FORTRAN Polarization Models
Waluschka, Eugene; Meister, Gerhard; Voss, Kenneth; Moyer, Daid; [2007]; 1 pp.; In English; SPIE Optics and Photonics Conference, 26-30 Aug. 2007, San Diego,CA, USA; Copyright; Avail.: Other Sources; Abstract Only

The Visible/Infrared Imager/Radiometer Suite (VIIRS) collects visible/infrared imagery and radiometric data. The

radiometric requirements are such that the instrument's polarization sensitivity must be very well understood. This paper presents the ZEMAX and FORTRAN polarization ray trace models of the instrument's visible light path. This will include the measured optical surface reflectance data, the bandpass shapes and a comparison of the results of the two models.
Author
Infrared Imagery; Spectral Reflectance; Polarization; Infrared Radiometers

20070032088 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Temperature Evolution in Excitonic Absorptions of Cd(0.96)Zn(0.04) Materials
Quijada, Manuel A.; Henry, Ross; Auagust 26, 2007; 1 pp.; In English; SPIE Optics and Photonics Conference, 26-30 Aug. 2007, San Diego, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

We report cryogenic optical properties of Cd(0.96)Zn(0.04)Te wafers that are used as substrate seed layers in HgCdTe focal-plane array detectors. These studies are motivated by the fact that the substrate optical properties influence the overall detector performance. The studies consist of measuring the sample frequency dependent transmittance (T) and reflectance (R) above and below the optical band-gap in the UV/Visible and infrared frequency ranges, and with temperature variation of the sample from 5 to 300 K. These measurements show that the optical gap near 1.49 eV at 300 K increases to 1.62 eV at 5 K. Finally, we observe sharp absorption peaks near this gap energy at low temperatures. The close proximity of these peaks to the optical transition threshold suggests that they originate from the creation of bound electron-hole pairs or excitons. The decay of these excitonic absorptions may contribute to a photoluminescence and transient background response of these back-illuminated HgCdTe CCD detectors.
Author
Mercury Cadmium Tellurides; Optical Properties; Transmittance; Reflectance; Frequency Measurement; Frequency Ranges; Infrared Radiation

Subject Term Index

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