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Personal Author Index

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01
AERONAUTICS (GENERAL)

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

20030065891 NASA Glenn Research Center, Cleveland, OH, USA
Steady and Unsteady Flow Field Measurements Within a NASA 22-Inch Fan Model
Podboy, Gary G.; Krupar, Martin J.; Helland, Stephen M.; Hughes, Christopher E.; July 2003; 35 pp.; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2003, Reno, NV, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS-22-781-30-08
Report No.(s): NASA/TM-2003-212329; NAS 1.15:212329; E-13924; AIAA Paper 2002-1033; No Copyright; Avail: CASI; A03, Hardcopy

Results are presented of an experiment conducted to investigate possible sources of fan noise in the flow developed by a 22-in. (55.9 cm) diameter turbofan model. Flow diagnostic data were acquired to identify possible sources of both tone and broadband noise. Laser Doppler velocimetry was used to characterize the tip flows that develop within the rotor blade passages, the wake flow downstream of the rotor, and the shock waves that develop on the blades when operated at transonic relative tip speeds. Single-point hot-wire measurements were made in the rotor wake to determine the frequency content and the length scales of the flow unsteadiness. The results document the changes in the rotor wake flow with both rotor speed and axial distance downstream of the rotor. The data also show the tip flow development within the blade passage, its migration downstream, and (at high rotor speeds) its merging with the blade wake of the following blade. Data also depict the variation of the tip flow with tip clearance. LDV data obtained within the blade passages at high rotor speeds illustrate the passage-to-passage variation of the mean shock position. Spectra computed from the single-point hot-wire measurements illustrate how the energy in the flow oscillations is split between periodic and random components, and how this split varies with both radial and axial position in the rotor wake.
Author
Steady Flow; Unsteady Flow; Flow Distribution; Turbofans; Models; Aerodynamic Noise; Wakes; Rotor Speed

02
AERODYNAMICS

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

20030065818 Georgia Inst. of Tech., Atlanta, GA, USA
Application of Circulation Control Technology to Airframe Noise Reduction
Ahuja, K. K.; Sankar, L. N.; Englar, R. J.; Munro, Scott E.; Li, Yi; Gaeta, R. J.; May 31, 2003; 179 pp.; In English; See also 20030065819 - 20030065826; Original contains black and white illustrations
Contract(s)/Grant(s): NAG1-2146
Report No.(s): GTRI-A5928/2003-1; No Copyright; Avail: CASI; A09, Hardcopy

This report is a summary of the work performed by Georgia Tech Research Institute (GTRI) under NASA Langley Grant NAG-1-2146, which was awarded as a part of NASA's Breakthrough Innovative Technologies (BIT) initiative. This was a three-year program, with a one-year no-cost extension. Each year's study has been an integrated effort consisting of computational fluid dynamics, experimental aerodynamics, and detailed noise and flow measurements. Year I effort examined

the feasibility of reducing airframe noise by replacing the conventional wing systems with a Circulation Control Wing (CCW), where steady blowing was used through the trailing edge of the wing over a Coanda surface. It was shown that the wing lift increases with CCW blowing and indeed for the same lift, a CCW wing was shown to produce less noise. Year 2 effort dealt with a similar study on the role of pulsed blowing on airframe noise. The main objective of this portion of the study was to assess whether pulse blowing from the trailing edge of a CCW resulted in more, less, or the same amount of radiated noise to the farfield. Results show that a reduction in farfield noise of up to 5 dB is measured when pulse flow is compared with steady flow for an equivalent lift configuration. This reduction is in the spectral region associated with the trailing edge jet noise. This result is due to the unique advantage that pulsed flow has over steady flow. For a range of frequencies, more lift is experienced with the same mass flow as the steady case. Thus, for an equivalent lift and slot height, the pulsed system can operate at lower jet velocities, and hence lower jet noise. The computational analysis showed that for a given time-averaged mass flow rate, pulsed jets give a higher value of C(sub l) and a higher L/D than equivalent steady jets. This benefit is attributable to higher instantaneous jet velocities, and higher instantaneous C(sub mu) values for the pulsed jet. Pulsed jet benefits increase at higher frequencies. However, these advantages are somewhat offset by the unsteadiness in the loads, which will cause structural vibrations and fatigue. Additional studies must be done, perhaps with multiple jets on the upper and lower surfaces, to smooth out the fluctuations in lift while retaining the benefits. The rest of the effort was devoted to examining ways of reducing flap edge noise by blowing air through a Coanda nozzle over a rounded tip of the flap. In this case, we were successful in moving the tip vortex away from the tip, but the device producing the blowing was noisy and we were unable to examine the noise benefits, although we believe that the movement of the tip vortex far from the tip should provide noise benefits. It should be noted that in an effort to understand the fluid dynamics and the aeroacoustics of a jet blowing over a Coanda surface, we also carried out a very extensive study of the high aspect ratio slot jets. A first-ever set of far-field noise spectra were measured for jets exhausting from slots with aspect ratios in the range 100 to 3000. Parallel measurements of velocity profiles, length scales and convection velocities were measured to understand the noise generation of high aspect ratio jets. Attempts were also made to develop jet noise prediction schemes for such jets. Much of the work done under this effort has been described in five conference papers and two doctoral theses. The first year s work on the use of steady blowing was described in two AIAA papers presented at the 2001 AIAA Aerospace Sciences Meeting in Reno. Subsequent work was presented at the 9th AIMCEAS Aeroacoustics Conference and Exhibit held at Hilton Head May 12-13. Another paper is to be presented at the 2004 AIAA Aerospace Sciences Meeting in Reno in January 2004. All six papers are included with this report as Appendices. The bulk of the experimental work done in an effort to produce a pulsed flow that is free of upstream noise is also attached as an Appendix.

Author

Aeroacoustics; Aerodynamic Noise; Computational Fluid Dynamics; Jet Aircraft Noise; Noise Reduction; Surface Noise Interactions; Circulation Control Airfoils; Blowing

20030065819 Georgia Inst. of Tech., Atlanta, GA, USA

Effect of Pulsed Blowing on Farfield Noise

Gaeta, R. J.; Ahuja, K. K.; Hellman, B.; Combier, R.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. G-i - G-18; In English; See also 20030065818; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

This portion of the report documents the results of an experimental program, which focused on pulsed blowing from the trailing edge of a CCW. The main objective of this study was to assess whether pulsed blowing resulted in more, less, or the same amount of radiated noise to the farfield. Results show that a reduction in far-field noise of up to 5 dB is measured when pulse flow is compared to steady flow for an equivalent lift configuration. This reduction is in the spectral region associated with the trailing edge jet noise. This result is due to the unique advantage that pulsed flow has over steady flow. For a range of frequencies, more lift is experienced with the same mass flow as the steady case. Thus, for an equivalent lift and slot height, the pulsed system can operate at lower jet velocities, and hence lower jet noise. At low frequencies (below 1 kHz), the pulsed flow configuration generated more noise in the farfield. This is most likely due to the pulsing mechanism itself. Since the high pressure air feeding the pulsing mechanism was first passed through a high performance muffler, it is likely that this increase in not due to upstream valve noise. Most likely, the impulsive component of the air that periodically fills the plenum causes a broadband source that reaches the farfield. Although the benefit of a pulse trailing edge jet is evident from a mass flow usage and jet noise perspective, attention should be paid towards the design of a viable pulsing system. Future research program in this area should concentrate on the development of a ‘quiet’ pulsing device.

Author

Jet Aircraft Noise; Noise Reduction; Aerodynamic Configurations; Aeroacoustics; Trailing Edge Flaps

20030065820 Georgia Tech Research Inst., Atlanta, GA, USA

Flap-Edge Blowing Experiments

Gaeta, R. J.; Englar, R. J.; Ahuja, K. K.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. H-1 - H-10; In English; See also 20030065818; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

This Appendix documents the salient results from an effort to mitigate the so-called flap-edge noise generated at the split between a flap edge that is deployed and the undeployed flap. Utilizing a Coanda surface installed at the flap edge, steady blowing was used in an attempt to diminish the vortex strength resulting from the uneven lift distribution. The strength of this lifting vortex was augmented by steady blowing over the deployed flap. The test article for this study was the same 2D airfoil used in the steady blowing program reported earlier (also used in pulsed blowing tests, see Appendix G), however its trailing edge geometry was modified. An exact duplicate of the airfoil shape was made out of fiberglass with no flap, and in the clean configuration. It was attached to the existing airfoil to make an airfoil that has half of its flap deployed and half un-deployed. Figure 1 shows a schematic of the planform showing the two areas where steady blowing was introduced. The flap-edge blowing or the auxiliary blowing was in the direction normal to the freestream velocity vector. Slot heights for the blowing chambers were on the order of 0.0 14 inches.

Author (revised)

Aeroacoustics; Coanda Effect; Upper Surface Blowing; Acoustic Measurement; Trailing Edges; Split Flaps; Aerodynamic Noise

20030065821 Georgia Inst. of Tech., Atlanta, GA, USA

Noise Reduction Through Circulation Control

Munro, Scott E.; Ahuja, K. K.; Englar, Robert J.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. A-1 - A-38; In English; See also 20030065818; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Circulation control technology uses tangential blowing around a rounded trailing edge or a leading edge to change the force and moment characteristics of an aerodynamic body. This technology has been applied to circular cylinders, wings, helicopter rotors, and even to automobiles for improved aerodynamic performance. Only limited research has been conducted on the acoustics of this technology. Since wing flaps contribute to the environmental noise of an aircraft, an alternate blown high lift system without complex mechanical flaps could prove beneficial in reducing the noise of an approaching aircraft. Thus, in this study, a direct comparison of the acoustic characteristics of high lift systems employing a circulation control wing configuration and a conventional wing flapped configuration has been made. These results indicate that acoustically, a circulation control wing high lift system could be considerably more acceptable than a wing with conventional mechanical flaps.

Author

Aerodynamic Configurations; Tangential Blowing; Circulation Control Airfoils; Noise Reduction

20030065822 Georgia Inst. of Tech., Atlanta, GA, USA

Numerical Simulations of the Steady and Unsteady Aerodynamic Characteristics of a Circulation Control Wing Airfoil

Liu, Yi; Sankar, Lakshmi N.; Englar, Robert J.; Ahuja, Krishan K.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. B-1 - B-12; In English; See also 20030065818; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The aerodynamic characteristics of a Circulation Control Wing (CCW) airfoil have been numerically investigated, and comparisons with experimental data have been made. The configuration chosen was a supercritical airfoil with a 30 degree dual-radius CCW flap. Steady and pulsed jet calculations were performed. It was found that the use of steady jets, even at very small mass flow rates, yielded a lift coefficient that is comparable or superior to conventional high-lift systems. The attached flow over the flap also gave rise to lower drag coefficients, and high L/D ratios. Pulsed jets with a 50% duty cycle were also studied. It was found that they were effective in generating lift at lower reduced mass flow rates compared to a steady jet, provided the pulse frequency was sufficiently high. This benefit was attributable to the fact that the momentum coefficient of the pulsed jet, during the portions of the cycle when the jet was on, was typically twice as much as that of a steady jet.

Author

Aerodynamic Characteristics; Aerodynamic Coefficients; Circulation Control Airfoils; Computerized Simulation; Navier-Stokes Equation

20030065823 Georgia Inst. of Tech., Atlanta, GA, USA
Aeroacoustics of a High Aspect-Ratio Jet
Munro, Scott E.; Ahuja, K. K.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. C-1 - C-18; In English; See also 20030065818; Original contains black and white illustrations
Contract(s)/Grant(s): NAG1-2146; No Copyright; Avail: CASI; A03, Hardcopy

Circulation control wings are a type of pneumatic high-lift device that have been extensively researched as to their aerodynamic benefits. However, there has been little research into the possible airframe noise reduction benefits of a circulation control wing. The key element of noise is the jet noise associated with the jet sheet emitted from the blowing slot. This jet sheet is essentially a high aspect-ratio rectangular jet. Thus, to fully understand the noise of a circulation control wing, the noise of high aspect-ratio rectangular jets must also be understood. A high aspect-ratio nozzle was fabricated to study the general characteristics of high aspect-ratio jets with aspect ratios from 100 to 3000. The jet noise of this nozzle was proportional to the 8‘ power of the jet velocity. It was also found that the jet noise was proportional to the slot height to the 312 power and slot width to the 1/2 power.
Author
Aeroacoustics; Jet Aircraft Noise; Circulation Control Airfoils; Acoustic Measurement; Nozzle Geometry

20030065824 Georgia Inst. of Tech., Atlanta, GA, USA
Fluid Dynamics of a High Aspect-Ratio Jet
Munro, Scott E.; Ahuja, K. K.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. D-1 - D-16; In English; See also 20030065818; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Circulation control wings are a type of pneumatic high-lift device that have been extensively researched as to their aerodynamic benefits. However, there has been little research into the possible airframe noise reduction benefits of a circulation control wing. The key element of noise is the jet noise associated with the jet sheet emitted from the blowing slot. High aspect-ratio jet acoustic results (aspect-ratios from 100 to 3,000) from a related study showed that the jet noise of this type of jet was proportional to the slot height to the 3/2 power and slot width to the 1/2 power. Fluid dynamic experiments were performed in the present study on the high aspect-ratio nozzle to gain understanding of the flow characteristics in an effort to relate the acoustic results to flow parameters. Single hot-wire experiments indicated that the jet exhaust from the high aspect-ratio nozzle was similar to a 2-d turbulent jet. Two-wire space-correlation measurements were performed to attempt to find a relationship between the slot height of the jet and the length-scale of the flow noise generating turbulence structure. The turbulent eddy convection velocity was also calculated, and was found to vary with the local centerline velocity, and also as a function of the frequency of the eddy.
Author
High Aspect Ratio; Flow Characteristics; Jet Aircraft Noise; Turbulent Jets; Wing Slots

20030065825 Georgia Inst. of Tech., Atlanta, GA, USA
Development of a Prediction Scheme for High Aspect-Ratio Jet Noise
Munro, Scott E.; Ahuja, K. K.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. E-1 - E-16; In English; See also 20030065818; No Copyright; Avail: CASI; A03, Hardcopy

Circulation control wings are a type of pneumatic high-lift device that have been extensively researched as to their aerodynamic benefits. However, there has been little research into the possible airframe noise reduction benefits of a circulation control wing. The key element of noise is the jet noise associated with the jet sheet emitted from the blowing slot. This jet sheet is essentially a high aspect-ratio rectangular jet. A recent study on high aspect-ratio jet noise was performed on a nozzle with aspect-ratios ranging from 100 to 3,000. In addition to the acoustic data, fluid dynamic measurements were made as well. This paper uses the results of these two studies and attempts to develop a prediction scheme for high aspect-ratio jet noise
Author
Aerodynamic Noise; Jet Aircraft Noise; Prediction Analysis Techniques; Nozzle Geometry; Aeroacoustics

20030065826 Georgia Inst. of Tech., Atlanta, GA, USA
Computational Evaluation of the Steady and Pulsed Jet Effects on the Performance of a Circulation Control Wing Section
Liu, Yi; Sankar, Lakshmi N.; Englar, Robert; Ahuja, K.; Gaeta, R.; Application of Circulation Control Technology to Airframe Noise Reduction; May 31, 2003, pp. F-1 - F-14; In English; See also 20030065818; No Copyright; Avail: CASI; A03, Hardcopy

Circulation Control Wing (CCW) technology is a very effective way of achieving very high lift coefficients needed by aircraft during take-off and landing. This technology can also be used to directly control the flow field over the wing. Compared to a conventional high-lift system, a Circulation Control Wing (CCW) can generate the required values of lift coefficient C(sub L,max) during take-off/landing with fewer or no moving parts and much less complexity. Earlier designs of CCW configurations used airfoils with a large radius rounded trailing edge to maximize the lift benefit. However, these designs also produced very high drag. These high drag levels associated with the blunt, large radius trailing edge can be prohibitive under cruise conditions when Circulation Control is no longer necessary. To overcome this difficulty, an advanced CCW section, i.e., a circulation hinged flap was developed to replace the original rounded trailing edge CC airfoil. This concept developed by Englar is shown. The upper surface of the CCW flap is a large-radius arc surface, but the lower surface of the flap is flat. The flap could be deflected from 0 degrees to 90 degrees. When an aircraft takes-off or lands, the flap is deflected as in a conventional high lift system. Then this large radius on the upper surface produces a large jet turning angle, leading to high lift. When the aircraft is in cruise, the flap is retracted and a conventional sharp trailing edge shape results, greatly reducing the drag. This kind of flap does have some moving elements that increase the weight and complexity over an earlier CCW design. But overall, the hinged flap design still maintains most of the Circulation Control high lift advantages, while greatly reducing the drag in cruising condition associated with the rounded trailing edge CCW design. In the present work, an unsteady three-dimensional Navier-Stokes analysis procedure has been developed and applied to this advanced CCW configuration. The solver can be used in both a 2-D and a 3-D mode, and can thus model airfoils as well as finite wings. The jet slot location, slot height, and the flap angle can all be varied easily and individually in the grid generator and the flow solver. Steady jets, pulsed jets, the leading edge and trailing edge blowing can all be studied with this solver.
Author
Computational Grids; Navier-Stokes Equation; Circulation Control Airfoils; Applications Programs (Computers); Computerized Simulation; Computational Fluid Dynamics

20030065839 Boeing Co., Seattle, WA, USA
Supersonic Test of the 10-Inch Bifurcated Two-Stage Supersonic Inlet (BTSSI)
Carlin, C. M.; Frisch, I.; Kolden, J. J.; Koncsek, J. L.; Marrs, K. J.; Mayer, D. W.; McMahon, S. L.; Milligan, K. H.; Sommerfield, D. M.; July 2003; 210 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS3-25963; WBS-22-714-01-38
Report No.(s): NASA/CR-2003-212313; NAS 1.26:212313; E-13902; No Copyright; Avail: CASI; A10, Hardcopy

Experimental results from testing of a novel supersonic inlet model in NASA Glenn Research Center's 10- by 10-foot supersonic wind tunnel are presented. The patented inlet concept, called Two-Stage Supersonic Inlet (TSSI), incorporates a large cavity, or throat slot, in the supersonic diffuser intended to enhance the stability of the normal shock. The present embodiment of the concept is a bifurcated twin-duct) design. During the course of testing an unusual 'semi-started' mode of operation was encountered. The inlet was able to spill up to 30 percent of the captured airstream without fully expelling the normal shock. In this mode, the total pressure recovery dropped approximately 6 percent without increasing steady-state distortion. Dynamic instrumentation at the cowl lip station indicates the semi-start mode may be a series of unstart/restart cycles with frequency ranging from 0.2 to 20 Hz. Engine face total pressure measurements indicate a modest impact due to this event. However, since the current test article does not have a representative subsonic diffuser (and is in fact separated), it is unclear how this mode of operation would effect an engine. Further investigation of this phenomenon is required before it is fully understood. Prior testing of the TSSI concept allowed extension of fully started inlet operation to regions of significantly reduced supply flow without reducing recovery. The test article was a smaller scale than the present test and was a single duct design. In the present test, the expanded range of stable operation with high recovery was not realized.
Author
Wind Tunnel Tests; Supersonic Diffusers; Supersonic Inlets; Pressure Measurement; Pressure Recovery; Steady State; Distortion

20030065862 NASA Langley Research Center, Hampton, VA, USA
Aerodynamics for Revolutionary Air Vehicles
Sellers, William L., III; Singer, Bart A.; Leavitt, Laurence D.; [2003]; 29 pp.; In English; 21st Applied Aerodynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3785; Copyright; Avail: CASI; A03, Hardcopy

Aeronautics research has seriously declined partly because of the perception that it is a mature science and only incremental improvements are possible. Recent aeronautics roadmapping activities at NASA Langley paint a different picture of the future. Breakthroughs are still felt to be possible if we expand the current design space of today's vehicles and optimize

the airspace and vehicles as a system. The paper describes some of the challenges that the aircraft and airline industry face. These challenges include political, technical and environmental issues. Examples of the opportunities and technologies that could provide a different vision for the future are discussed.
Author
Aerodynamics; Design Optimization; Technology Assessment; Aircraft Design

20030065895 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
On the Vortex Sound from Rotating Rods
Yudin, E. Y.; Zhurnal Tekhnicheskoi Fiziki; January 1947; Volume 14, No. 9, pp. 561; In English
Report No.(s): NACA-TM-1136; No Copyright; Avail: CASI; A03, Hardcopy

The motion of different bodies imersed in liquid or gaseous media is accompanied by characteristic sound which is excited by the formation of unstable surfaces of separation behind the body, usually disintegrating into a system of discrete vortices(such as the Karman vortex street due to the flow about an infintely long rod, etc.).In the noise from fans,pumps,and similar machtnery, vortexnQif3eI?Yequently predominates. The purpose of this work is to elucidate certain questions of the dependence ofthis sound upon the aerodynamic parameters and the tip speed of the rotating rods,or blades. Although scme material is given below,insufficientto calculate the first rough approximation to the solution of this question,such as the mechanics of vortex formation,never the less certain conclusions maybe found of practical application for the reduction of noise from rotating blades.
Author
Tip Speed; Rods; Rotation; Aerodynamic Characteristics

20030065911 NASA Langley Research Center, Hampton, VA, USA
Opening Loads Analyses for Various Disk-Gap-Band Parachutes
Cruz, J. R.; Kandis, M.; Witkowski, A.; [2003]; 18 pp.; In English; 17th AIAA Aerodynamic Decelerator Systems Technology Conference and Seminar, 19-22 May 2003, Monterey, CA, USA
Report No.(s): AIAA Paper 2003-2131; No Copyright; Avail: CASI; A03, Hardcopy

Detailed opening loads data is presented for 18 tests of Disk-Gap-Band (DGB) parachutes of varying geometry with nominal diameters ranging from 43.2 to 50.1 ft. All of the test parachutes were deployed from a mortar. Six of these tests were conducted via drop testing with drop test vehicles weighing approximately 3,000 or 8,000 lb. Twelve tests were conducted in the National Full-Scale Aerodynamics Complex 80- by 120-foot wind tunnel at the NASA Ames Research Center. The purpose of these tests was to structurally qualify the parachute for the Mars Exploration Rover mission. A key requirement of all tests was that peak parachute load had to be reached at full inflation to more closely simulate the load profile encountered during operation at Mars. Peak loads measured during the tests were in the range from 12,889 to 30,027 lb. Of the two test methods, the wind tunnel tests yielded more accurate and repeatable data. Application of an apparent mass model to the opening loads data yielded insights into the nature of these loads. Although the apparent mass model could reconstruct specific tests with reasonable accuracy, the use of this model for predictive analyses was not accurate enough to set test conditions for either the drop or wind tunnel tests. A simpler empirical model was found to be suitable for predicting opening loads for the wind tunnel tests to a satisfactory level of accuracy. However, this simple empirical model is not applicable to the drop tests.
Author
Parachutes; Parachute Descent; Drop Tests; Loads (Forces); Wind Tunnel Tests

20030065926 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Planing of Watercraft
Wagner, Herbert; Jahrbuch der Schiffbautechnik; April 1948; Volume 34, pp. 205-227; In English; Original contains black and white illustrations
Report No.(s): NACA-TM-1139; No Copyright; Avail: CASI; A03, Hardcopy

The present report deals with the processes accompanying the planing of a planing boat or a seaplane on water . The study is largely based upon theoretical investigations; mathematical problems and proofs are not discussed. To analyze theoreticaly actual planing processes, giving due consideration to all aspects of the problem, is probably not possible. The theories therefore treat various simple limiting cases, which in their entirety give a picture of the planing processes and enable the interpretation of the experimental results. The discussion is concerned with the stationary planing attitude: the boat planes at a constant speed V on an originally smooth surface.
Author
Surface Water; Boats; Hydroplaning; Airfoils; Angle Of Attack

20030066218 NASA Langley Research Center, Hampton, VA, USA

Finite Volume Numerical Methods for Aeroheating Rate Calculations from Infrared Thermographic Data

Daryabeigi, Kamran; Berry, Scott A.; Horvath, Thomas J.; Nowak, Robert J.; [2003]; 11 pp.; In English; 36th AIAA Thermophysics Conference, 23-26 Jun. 2003, Orlando, FL, USA; Original contains color and black and white illustrations

Report No.(s): AIAA Paper 2003-3634; No Copyright; Avail: CASI; A03, Hardcopy

The use of multi-dimensional finite volume numerical techniques with finite thickness models for calculating aeroheating rates from measured global surface temperatures on hypersonic wind tunnel models was investigated. Both direct and inverse finite volume techniques were investigated and compared with the one-dimensional semi -infinite technique. Global transient surface temperatures were measured using an infrared thermographic technique on a 0.333-scale model of the Hyper-X forebody in the Langley Research Center 20-Inch Mach 6 Air tunnel. In these tests the effectiveness of vortices generated via gas injection for initiating hypersonic transition on the Hyper-X forebody were investigated. An array of streamwise orientated heating striations were generated and visualized downstream of the gas injection sites. In regions without significant spatial temperature gradients, one-dimensional techniques provided accurate aeroheating rates. In regions with sharp temperature gradients due to the striation patterns two-dimensional heat transfer techniques were necessary to obtain accurate heating rates. The use of the one-dimensional technique resulted in differences of 20% in the calculated heating rates because it did not account for lateral heat conduction in the model.

Author

Aerodynamic Heating; Numerical Analysis; Hypersonic Wind Tunnels; Wind Tunnel Models; Finite Volume Method

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*.

20030065620 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA

Long Term Implementation of a 100 Percent Checked Baggage Screening System: A Value Focused Thinking Approach

Meade, Quincy; Mar. 2003; 121 pp.; In English; Original contains color illustrations

Report No.(s): AD-A413480; AFIT/GEE/ENS/03-02; No Copyright; Avail: CASI; A06, Hardcopy

The terrorist attacks of 11 September 2001, carried out via aircraft hijackings, clearly demonstrated the massive destruction potential when vulnerabilities in the aviation system are exploited. Airport security measures have since been strengthened and new measures have been set in place. With the passage of the Aviation Transportation and Security Act (ATSA) of 2001 the checked baggage systems at U.S. Airports are now required to screen all checked bags with explosive detection devices. This is a significant increase from the small percentage of bags that were previously screened. The original 2009 deadline was changed to 31 December 2002 and this change forced airports to implement interim screening systems. These systems can impact the efficient processing of passengers and baggage. A long term solution is needed for a 100 percent checked baggage system that provides the required security while minimizing negative impacts to aviation stakeholders including the airport operators, airlines, passengers, and the Transportation Security Administration. This thesis, focusing on the Dayton International Airport, uses a Value Focused Thinking methodology to build a value model for evaluating potential long term solutions for 100 percent checked baggage system alternatives.

DTIC

Airport Security; Civil Aviation; Baggage; Ground Handling

20030065737 Illinois Univ., Urbana, IL, USA

Human Error Analysis of Fatal General Aviation Accidents, 1990-1998; Application of a Revised Taxonomy of Unsafe Acts

Faaborg, Troy P.; May 21, 2003; 126 pp.; In English

Report No.(s): AD-A414093; C102-930; No Copyright; Avail: CASI; A07, Hardcopy

Civil flights (non-military) in the USA (U.S.) are classified as either General Aviation (GA) or air carrier operations. General aviation activities include recreational flying, flight instruction, agricultural operations, sightseeing, and business travel (U & Baker, 1999). The aircraft involved in GA flying may be piloted by a variety of people with a valid pilot license and approved medical history, but belonging to a wide range of age groups. The aircraft flown by GA pilots include airplanes,

helicopters, balloons, and gliders. Each year, the National Transportation Safety Board (NTSB) records about 2000 GA crashes, which claim about 750 lives (National Safety Council, 1997). Between 1990-1996, GA accounted for 93% of all aviation crashes and 78% of all aviation fatalities. In fact, a pilot flying under the auspices of general aviation is nearly 10 times more likely to be involved in an accident than a military air crewmember (USAF, 2003), more than 11 times more likely than a commercial air crewmember (NTSB 2003b; NTSB, 2003c), and almost 50 times more likely to be involved in a fatal crash than large scale commercial pilots (NTSB, 2003a).
DTIC
Error Analysis; General Aviation Aircraft; Aircraft Accidents; Aircraft Accident Investigation

20030065934 Army Aviation Systems Command, Moffett Field, CA, USA
A General Simulation Method for Multiple Bodies in Proximate Flight
Meakin, Robert L.; [2003]; 19 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3831; No Copyright; Avail: CASI; A03, Hardcopy

Methods of unsteady aerodynamic simulation for an arbitrary number of independent bodies flying in close proximity are considered. A novel method to efficiently detect collision contact points is described. A method to compute body trajectories in response to aerodynamic loads, applied loads, and inter-body collisions is also given. The physical correctness of the methods are verified by comparison to a set of analytic solutions. The methods, combined with a Navier-Stokes solver, are used to demonstrate the possibility of predicting the unsteady aerodynamics and flight trajectories of moving bodies that involve rigid-body collisions.
Author
Unsteady Aerodynamics; Midair Collisions; Aerodynamic Loads; Trajectories; Prediction Analysis Techniques

20030065976 NASA Ames Research Center, Moffett Field, CA, USA
Aviation Data Integration System
Kulkarni, Deepak; Wang, Yao; Windrem, May; Patel, Hemil; Keller, Richard; [June 25, 2003]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

During the analysis of flight data and safety reports done in ASAP and FOQA programs, airline personnel are not able to access relevant aviation data for a variety of reasons. We have developed the Aviation Data Integration System (ADIS), a software system that provides integrated heterogeneous data to support safety analysis. Types of data available in ADIS include weather, D-ATIS, RVR, radar data, and Jeppesen charts, and flight data. We developed three versions of ADIS to support airlines. The first version has been developed to support ASAP teams. A second version supports FOQA teams, and it integrates aviation data with flight data while keeping identification information inaccessible. Finally, we developed a prototype that demonstrates the integration of aviation data into flight data analysis programs. The initial feedback from airlines is that ADIS is very useful in FOQA and ASAP analysis.
Derived from text
Airline Operations; Flight Safety; Information Systems; Data Integration

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*.

20030065625 Federal Aviation Administration, Atlantic City, NJ, USA
Study of an ATC Baseline for the Evaluation of Team Configurations: Information Requirements
Willems, Ben; Heiney, Michele; Grumman, Northrop; Sollenberger, Randy; Nov. 2002; 89 pp.; In English
Report No.(s): AD-A413328; DOT/FAA/CT-TN02/17; No Copyright; Avail: CASI; A05, Hardcopy

This study investigated the information needs of Air Traffic Control Specialists (ATCSs) relative to their working position. The working positions used in this study included the current radar ATCS position and the concept airspace coordinator position. Thirty current Certified Professional Controllers from Air Route Traffic Control Centers within the Continental USA volunteered to participate in a human-in-the-loop experiment. ATCSs worked in teams of three, either on a radar, upstream data, or airspace coordinator position. Within the team of three, two ATCSs always worked on a radar position, while the third

rotated through radar, upstream D-side, and airspace coordinator positions. After they had controlled simulated air traffic on a high fidelity simulation of the Display System Replacement System, the participants answered a detailed Information Requirement Questionnaire (IRQ). The IRQ asked about types of radar, flight, and weather information needed for future automation functions for the radar and airspace coordinator positions. The future automation functions included conflict probe, resolution, and trial planning, direct routing advisory, flight path monitor, and load smoother. The participants indicated that the airspace coordinator needed different information from the automation than the radar ATCS. They also rated the importance of the automation functions differently depending on the ATCS position that would use them. Therefore, we need to take into account the roles and responsibilities of the ATCS when deciding the format and amount of information displayed on automation tools.
DTIC
Air Traffic Control; Air Traffic Controllers (Personnel)

20030065892 NASA Ames Research Center, Moffett Field, CA, USA
Tactical Maneuvering Using Immunized Sequence Selection
Kaneshige, John; KrishnaKumar, K.; Shung, Felix; [2003]; 4 pp.; In English; AIAA 'Unmanned Unlimited' Systems Technologies, and Operations-Aerospace, Land, and Sea Conference, 15-18 Sep. 2003, San Diego, CA, USA
Contract(s)/Grant(s): RTOP 704-30-62; No Copyright; Avail: CASI; A01, Hardcopy

This paper describes a tactical maneuvering system that uses an artificial immune system based approach for selecting maneuver sequences. This approach combines the problem solving abilities of genetic algorithms with the memory retention characteristics of an immune system. Of significant importance here is the fact that the tactical maneuvering system can make time-critical decisions to accomplish near-term objectives within a dynamic environment. These objectives can be received from a human operator, autonomous executive, or various flight planning specialists. Simulation tests were performed using a high performance military aircraft model. Results demonstrate the potential of using immunized sequence selection in order to accomplish tactical maneuvering objectives ranging from flying to a location while avoiding unforeseen obstacles, to performing relative positioning in support of air combat maneuvering.
Author
Aircraft Maneuvers; Pilotless Aircraft; Flight Management Systems; Autonomous Navigation; Genetic Algorithms; Neural Nets; Man Machine Systems; Adaptive Control

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*.

20030065594 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Calculation of the Actual Cost of Engine Maintenance
Ezik, Oguz; Mar. 2003; 101 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412960; AFIT/GOR/ENS/03-06; No Copyright; Avail: CASI; A06, Hardcopy

The cost of military operations has been difficult to determine, yet considered of high importance. The cost of an operation is largely dependant upon the answers to subordinate questions involving the discrete costs of military activities, like supporting individual items, While different cost estimates have received attention from the media, the question arises as to how accurate these figures are, There have been numerous studies performed by the Operations Research analysts to minimize costs while allocating scarce resources, However, the values of these studies are dependent upon whether or not the cost figures used are sufficiently 'true' or accurate, This research deals with the true representation of cost, in particular true cost of engine maintenance, In order to reach that goal, the thesis effort aimed to first look at the archival methods and models used to prepare cost estimations for a weapon system or a task performed in the Air Force, The engine maintenance is one and an important one of these tasks, Looking at those previous studies gained us insight on what the cost elements and factors might be, The research also looks at some of the current practices serving the same purpose, The characteristics of all of those models are also discussed briefly, Four analytical steps helped to come up with the cost elements that should go into the 'actual' total cost of engine maintenance at the Base or Wing Level, The research provides detailed definitions of these consolidated elements and the relationships between them, The research also presents ways to gather the required data out of several databases whose

functions and data types are also briefly discussed, A case study would not be possible due to the fact that the data was not accessible.
DTIC
Aircraft Maintenance; Aircraft Engines; Cost Analysis; Operating Costs

20030065601 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Sensor-Craft Analytical Certification
Roberts, Ronald W., Jr.; Mar. 10, 2003; 110 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412966; AFIT/GAE/ENY/03-6; No Copyright; Avail: CASI; A06, Hardcopy

This study developed a multi-disciplinary conceptual design of a joined-wing sensor-craft. Initial analysis was conducted using an aluminum model. Linear fully stressed design and flexible aerodynamic trim were used to converge to a minimum weight design that was aerodynamically stable. This optimized design was buckling safe. A similar optimization process using nonlinear fully stressed design and flexible aerodynamic trim was conducted. The nonlinear structurally deformation was over ten times greater than the linear structural deformation. Again, the model was structurally and aerodynamically optimized. The linear optimization was repeated using a composite structural model incorporating Conformal Load-bearing Antenna Structures. This research demonstrated the importance of considering nonlinearity and the coupling of aero dynamic and structural design.
DTIC
Aircraft Design; Sensors; Joined Wings; Drone Aircraft

20030065629 Stanford Univ., Stanford, CA
Smart Patches for Monitoring Fatigue Crack Growth in Aircraft Structures
Ihn, Jeong-Beom; Chang, Fu-Kuo; Nov. 30, 2001; 30 pp.; In English
Contract(s)/Grant(s): F49620-99-1-0282
Report No.(s): AD-A414048; AFRL-SR-AR-TR-03-0187; No Copyright; Avail: CASI; A03, Hardcopy

A built-in cost-effective diagnostic system for monitoring crack growth in aircraft structures was developed, particularly for riveted fuselage joints and cracked aircraft parts with composite bonded patches. Different smart patch designs for crack growth monitoring at fuselage lab joints and cracked parts with composite bonded patches were developed and integrated with the corresponding aircraft parts. Using the diagnostic software, pre-selected diagnostic signals are propagated from a designated piezoelectric actuator to neighboring sensors. The corresponding sensor signals are recorded and compared with a baseline reference, which was recorded earlier. The signal processing technique and a damage index resulting from an interpretation algorithm were developed and implemented for extracting features related to crack growth conditions at the time of measurement. The damage index was verified by a crack propagation test on a notched aluminum plate which was fatigued under cycling loading. A fatigue test for multi-riveted aluminum lap joint (936 x 462 mm) with smart patches installed was performed and the damage index results were compared with conventional NDT methods including eddy current and ultrasonic scan. The probability of damage detection (POD) was assessed for the damage index comparing with two conventional NDT methods. Also, an aluminum plate repaired with boron/epoxy patch where smart patches were inserted was tested and the results were compared with the crack growth results by a visible inspection. The crack growth prediction of the damage index on both experiments showed a good agreement with NDT predictions as well as visual inspection results.
DTIC
Aircraft Structures; Crack Propagation; Fatigue (Materials); Cracking (Fracturing); Fatigue Tests

20030065638 NASA Langley Research Center, Hampton, VA, USA
Comparisons of the Impact Responses of a 1/5-Scale Model and a Full-Scale Crashworthy Composite Fuselage Section
Jackson, Karen E.; Fasanella, Edwin L.; Lyle, Karen H.; [2003]; 12 pp.; In English; American Helicopter Society 59th Annual Forum, 6-8 May 2003, Phoenix, AZ, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

A 25-fps vertical drop test of a 1/5-scale model composite fuselage section was conducted to replicate a previous test of a full-scale fuselage section. The purpose of the test was to obtain experimental data characterizing the impact response of the 1/5-scale model fuselage section for comparison with the corresponding full-scale data. This comparison is performed to assess the scaling procedures and to determine if scaling effects are present. For the drop test, the 1/5-scale model fuselage section was configured in a similar manner as the full-scale section, with lead masses attached to the floor through simulated seat rails. Scaled acceleration and velocity responses are compared and a general assessment of structural damage is made. To further quantify the data correlation, comparisons of the average acceleration data are made as a function of floor location

and longitudinal position. Also, the percentage differences in the velocity change (area under the acceleration curve) and the velocity change squared (proportional to kinetic energy) are compared as a function of floor location. Finally, correlation coefficients are calculated for corresponding 1/5- and full-scale data channels and these values are plotted versus floor location. From a scaling perspective, the differences between the 1/5- and full-scale tests are relatively small, indicating that appropriate scaling procedures were used in fabricating the test specimens and in conducting the experiments. The small differences in the scaled test data are attributed to minor scaling anomalies in mass, potential energy, and impact attitude.
Author
Scale Models; Scale Effect; Drop Tests; Data Correlation; Fuselages; Correlation Coefficients; Statistical Correlation

20030065657 Boeing Co., Saint Louis, MO, USA
Corrosion Pit to Crack Transition. Delivery Order 0051: Task 2
Sankaran, Krishnan K.; Weaver, Gary E.; Dec. 2002; 109 pp.; In English
Contract(s)/Grant(s): F33601-01-D-J001; Proj-2401
Report No.(s): AD-A414049; AFRL-VA-WP-TR-2003-3010; No Copyright; Avail: CASI; A06, Hardcopy

Corrosion is an economic burden for the USA Air Force (USAF) since repair and maintenance operations undertaken to mitigate its effects on legacy aircraft are typically over-conservative due to the lack of a reliable methodology to predict the future effects of corrosion on structural performance. Therefore, a need exists for the quantitative evaluation of the effects of corrosion on such failure modes as structural fatigue. Quantitative evaluation will enable the safe and economical operations of aircraft. Pitting is among the commonly observed type of corrosion damage in aircraft structures, as the heterogeneous microstructures of high-strength aluminium alloys such as 2024 and 7075, widely used in the construction of legacy aircraft, render them highly susceptible to this type of localized corrosion. Accordingly, quantitative modeling of corrosion damage by pitting and its effects on the fatigue behavior of aluminium alloys has received considerable attention. In this study, the fracture surfaces of broken corrosion fatigue test specimens were examined in detail in a scanning electron microscope (SEM) to develop an understanding of the nature of the transition of the corrosion damage into fatigue cracks. The purpose was to construct a quantitative data set of the corrosion damage metrics for use in developing and validating corrosion fatigue life prediction models. Available aluminum alloy 7075-T6 specimens, which had been subjected to varying levels of pitting corrosion, systematic characterization, and fatigue testing, were used for the fractographic investigation.
DTIC
Aircraft Maintenance; Aircraft Structures; Corrosion Tests; Fatigue (Materials); Pitting; Crack Propagation; Mathematical Models

20030065658 Naval Research Lab., Bay Saint Louis, MS
An Overview of Microbiologically Influenced Corrosion in Aircraft
Little, Brenda J.; Ray, Richard I.; Lee, Jason S.; Jan. 1997; 9 pp.; In English
Report No.(s): AD-A413907; NRL/PP/7303/02/0008; No Copyright; Avail: CASI; A02, Hardcopy

Most documented cases of microbiologically influenced corrosion (MIC) in aircraft are related to fungi. Fungi are dessicant-resistant microorganisms that can remain active down to a relative humidity of 65%. Fungi are on photosynthetic organisms, having a vegetative structure known as a hypha, the outgrowth of a single microscopic reproductive cell or spore. A mass of threadlike hyphae make up a mycelium (Figure 1).' Mycelia are capable of almost indefinite growth in the presence of adequate moisture and nutrients so that fungi often reach macroscopic dimensions. Yeasts are fungi that multiply by forming buds instead of mycelia. Fungi are ubiquitous in atmospheric and aquatic environments where they assimilate organic material and produce organic acids including oxalic, lactic, acetic, and citric. Spores, the nonvegetative dormant stage, can survive long periods of unfavorable growth conditions, e.g., drought and starvation. In the following sections fungal degradation of polymeric materials and fuels used in aircraft will be reviewed.
DTIC
Corrosion; Microscopy; Helicopters; Fungi

20030065663 NASA Langley Research Center, Hampton, VA, USA
Performance Analysis of a Cost-Effective Electret Condenser Microphone Directional Array
Humphreys, William M., Jr.; Gerhold, Carl H.; Zuckerwar, Allan J.; Herring, Gregory C.; Bartram, Scott M.; [2003]; 22 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference and Exhibit, 12-14 May 2003, Hilton Head, SC, USA
Report No.(s): AIAA Paper 2003-3195; No Copyright; Avail: CASI; A03, Hardcopy

Microphone directional array technology continues to be a critical part of the overall instrumentation suite for

experimental aeroacoustics. Unfortunately, high sensor cost remains one of the limiting factors in the construction of very high-density arrays (i.e., arrays containing several hundred channels or more) which could be used to implement advanced beamforming algorithms. In an effort to reduce the implementation cost of such arrays, the authors have undertaken a systematic performance analysis of a prototype 35-microphone array populated with commercial electret condenser microphones. An ensemble of microphones coupling commercially available electret cartridges with passive signal conditioning circuitry was fabricated for use with the Langley Large Aperture Directional Array (LADA). A performance analysis consisting of three phases was then performed: (1) characterize the acoustic response of the microphones via laboratory testing and calibration, (2) evaluate the beamforming capability of the electret-based LADA using a series of independently controlled point sources in an anechoic environment, and (3) demonstrate the utility of an electret-based directional array in a real-world application, in this case a cold flow jet operating at high subsonic velocities. The results of the investigation revealed a microphone frequency response suitable for directional array use over a range of 250 Hz - 40 kHz, a successful beamforming evaluation using the electret-populated LADA to measure simple point sources at frequencies up to 20 kHz, and a successful demonstration using the array to measure noise generated by the cold flow jet. This paper presents an overview of the tests conducted along with sample data obtained from those tests.
Author
Microphones; Arrays; Acoustic Properties; Aeroacoustics

20030065684 Air Force Research Lab., Wright-Patterson AFB, OH
Development and Validation of Airfoils for Global Range Transports
Tilmann, Carl P.; Brandt, Lee B.; Russell, Justin W.; Ramsay, Robyn R.; Hoehn, Thomas; Aug. 2000; 16 pp.; In English
Contract(s)/Grant(s): Proj-2304
Report No.(s): AD-A413922; AFRL-VA-WP-TP-2003-308; AIAA-2000-4509; No Copyright; Avail: CASI; A03, Hardcopy

The developmental process for an airfoil designed to be used on long-range transonic transport aircraft with large regions of natural laminar flow is described. Components of the development process that are discussed include mission-driven needs criteria, airfoil design method, experimental airfoil validation, and a variety of numerical validation procedures. Numerical analyses include flowfield prediction, boundary layer stability analysis and transition prediction, and force and moment assessment. Assessments are made at several off-design conditions. The overall goal is to develop and demonstrate the computational tools and analytical methods required for the optimal design of unconventional airfoils and wings for global range cruise flight.
DTIC
Airfoils; Supersonic Aircraft; Proving

20030065753 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Multimission Aircraft Design Study-Operational Scenarios
Coskuner, Nevin; Mar. 2003; 156 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412889; AFIT/GSE/ENY/03-01; No Copyright; Avail: CASI; A08, Hardcopy

In the most recent years, the Command, Control and Communications, Counter Measures, Intelligence, Surveillance and Reconnaissance (C3CMISR) aircrafts are used commonly in many NATO and UN Operations around the world. These aircrafts are AWACS, JSTARS, Rivet Joint, Compass Call and ABCCC. They provide close air support in the name of airborne surveillance, ground moving target surveillance, target reconnaissance, jamming, and command, control and communications issues in operational environments. Those aircrafts are tasked with a wide variety of missions than ever before in operational theaters and each one of them comprises a specific amount of cost and risk factors. As a new vision, while replacing the existing legacy systems, multi-mission architectures are taken into consideration for the C3CMISR missions. The stated objective is designing a one tail number Multi-Mission Aircraft (MMA) that includes all the C3CMISR tasks on one airframe. This study seeks some comments and advises about the MMA design technical feasibility. In order to search for these comments, four notional operational scenarios are created. First of all existing C3CMISR aircrafts are considered and evaluated in these operational scenarios and then different MMA architectures are defined and compared with the legacy systems in the name of adequacy.
DTIC
Aircraft Design; Military Operations

20030065843 ATK-Thiokol Propulsion, Brigham City, UT, USA

Enhanced Large Solid Rocket Motor Understanding Through Performance Margin Testing: RSRM Five-Segment Engineering Test Motor (ETM-3)

Huppi, Hal; Tobias, Mark; Seiler, James; [2003]; 12 pp.; In English; AIAA Joint Propulsion Conference, 21-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-97238

Report No.(s): AIAA Paper 2003-4958; No Copyright; Avail: CASI; A03, Hardcopy

The Five-Segment Engineering Test Motor (ETM-3) is an extended length reusable solid rocket motor (RSRM) intended to increase motor performance and internal environments above the current four-segment RSRM flight motor. The principal purpose of ETM-3 is to provide a test article for RSRM component margin testing. As the RSRM and Space Shuttle in general continue to age, replacing obsolete materials becomes an ever-increasing issue. Having a five-segment motor that provides environments in excess of normal opera- tion allows a mechanism to subject replacement materials to a more severe environment than experienced in flight. Additionally, ETM-3 offers a second design data point from which to develop and/or validate analytical models that currently have some level of empiricism associated with them. These enhanced models have the potential to further the understanding of RSRM motor performance and solid rocket motor (SRM) propulsion in general. Furthermore, these data could be leveraged to support a five-segment booster (FSB) development program should the Space Shuttle program choose to pursue this option for abort mode enhancements during the ascent phase. A tertiary goal of ETM-3 is to challenge both the ATK Thiokol Propulsion and NASA MSFC technical personnel through the design and analysis of a large solid rocket motor without the benefit of a well-established performance database such as the RSRM. The end result of this undertaking will be a more competent and experienced workforce for both organizations. Of particular interest are the motor design characteristics and the systems engineering approach used to conduct a complex yet successful large motor static test. These aspects of ETM-3 and more will be summarized.

Author

Mathematical Models; Solid Propellant Rocket Engines; Static Tests; Systems Engineering; Rocket Engine Design; Reusable Rocket Engines

20030065854 NASA Langley Research Center, Hampton, VA, USA

Sound Transmission Through a Curved Honeycomb Composite Panel

Klos, Jacob; Robinson, Jay H.; Buehrle, Ralph D.; [2003]; 9 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference and Exhibition, 12-14 May 2003, Hilton Head, SC, USA

Report No.(s): AIAA Paper 2003-3157; No Copyright; Avail: CASI; A02, Hardcopy

Composite structures are often used in aircraft because of the advantages offered by a high strength to weight ratio. However, the acoustical properties of these light and stiff structures can often be less than desirable resulting in high aircraft interior noise levels. In this paper, measurements and predictions of the transmission loss of a curved honeycomb composite panel are presented. The transmission loss predictions are validated by comparisons to measurements. An assessment of the behavior of the panel is made from the dispersion characteristics of transverse waves propagating in the panel. The speed of transverse waves propagating in the panel is found to be sonic or supersonic over the frequency range from 100 to 5000 Hz. The acoustical benefit of reducing the wave speed for transverse vibration is demonstrated.

Author

Composite Structures; Acoustics; Aircraft Noise; Transverse Waves; Curved Panels

20030065859 NASA Langley Research Center, Hampton, VA, USA

Aeroacoustics of Propulsion Airframe Integration: Overview of NASA's Research

Thomas, Russell H.; [2003]; 8 pp.; In English; NOISE-CON 2003: National Conference on Noise Control, 23-25 Jun. 2003, Cleveland, OH, USA

Report No.(s): NOISE-CON Paper 105; No Copyright; Avail: CASI; A02, Hardcopy

The integration of propulsion and airframe is fundamental to the design of an aircraft system. Many considerations influence the integration, such as structural, aerodynamic, and maintenance factors. In regard to the acoustics of an aircraft, the integration can have significant effects on the net radiated noise. Whether an engine is mounted above a wing or below can have a significant effect on noise that reaches communities below because of shielding or reflection of engine noise. This is an obvious example of the acoustic effects of propulsion airframe installation. Another example could be the effect of the pylon on the development of the exhaust plume and on the resulting jet noise. In addition, for effective system noise reduction the impact that installation has on noise reduction devices developed on isolated components must be understood. In the future, a focus on the aerodynamic and acoustic interaction effects of installation, propulsion airframe aeroacoustics, will become

more important as noise reduction targets become more difficult to achieve. In addition to continued fundamental component reduction efforts, a system level approach that includes propulsion airframe aeroacoustics will be required in order to achieve the 20 dB of perceived noise reduction envisioned by the long-range NASA goals. This emphasis on the aeroacoustics of propulsion airframe integration is a new part of NASA s noise research. The following paper will review current efforts and highlight technical challenges and approaches.
Author
Engine Airframe Integration; Noise Reduction; Jet Aircraft Noise

20030065872 National Advisory Committee for Aeronautics, Washington, DC, USA
Safeguards Against Flutter of Airplanes
deVries, Gerhard; August 1956; 95 pp.; In English
Report No.(s): NACA-TM-1423; No Copyright; Avail: CASI; A05, Hardcopy

This report is a complilation of practical rules, derived at the same time from theory and from experience, intended to guide the aeronautical engineer in the design of flutter-free airplanes. Rules applicable to the wing, the ailerons, flaps, tabs,tail surfaces, and fuselage are discussed.
Author
Flutter; Aircraft Design

20030065878 NASA Langley Research Center, Hampton, VA, USA
Reliability Assessment of a Robust Design Under Uncertainty for a 3-D Flexible Wing
Gumbert, Clyde R.; Hou, Gene J. -W.; Newman, Perry A.; [2003]; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-19858; NASA Order L-9291; NASA Order L-11206
Report No.(s): AIAA Paper 2003-4094; No Copyright; Avail: CASI; A03, Hardcopy

The paper presents reliability assessment results for the robust designs under uncertainty of a 3-D flexible wing previously reported by the authors. Reliability assessments (additional optimization problems) of the active constraints at the various probabilistic robust design points are obtained and compared with the constraint values or target constraint probabilities specified in the robust design. In addition, reliability-based sensitivity derivatives with respect to design variable mean values are also obtained and shown to agree with finite difference values. These derivatives allow one to perform reliability based design without having to obtain second-order sensitivity derivatives. However, an inner-loop optimization problem must be solved for each active constraint to find the most probable point on that constraint failure surface.
Author
Flexible Wings; Aircraft Design; Reliability Analysis; Computational Fluid Dynamics; Robustness (Mathematics); Three Dimensional Models

20030065882 NASA Marshall Space Flight Center, Huntsville, AL, USA
Evaluation of the Spherical Flange Concept for a Rocket Engine
Nichols, Jay; Tygielski, Philip; Urquidi, Ronald; Stangeland, Maynard L.; June 24, 2003; 4 pp.; In English; AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; No Copyright; Avail: CASI; A01, Hardcopy

Due to the inherent tolerance variability of hardware, flange misalignments occur during installation of mating components for a liquid propellant rocket engine. Flange misalignments include axial, lateral, and angular offsets. If these misalignments are high, they can impart significant loads into the two mating components. These significant loads can then be a driver in the design of the propellant ducts. Such was the case for the Rocketdyne RS-83 engine design for the Space Launch Initiative Program. To address this flange misalignment issue, Marshall Space Flight Center joined with Rocketdyne to develop and test a spherical flange system that allows for misalignment, yet reduces loads imparted, and at the same time provides sufficient sealing against leakage. The flange design was tested to evaluate and compare performance parameters such as misalignment and leakage. The environmental conditions ranged from -100 to 400 degrees Fahrenheit (F) with 1000 to 4000 pounds per square inch gage (psig) pressure. The desirable design features will be extracted and synthesized into a new flange design concept. This paper will address the spherical flange design and the test results.
Author
Flanges; Liquid Propellant Rocket Engines; Rocket Engine Design; Turbine Pumps; Sealing; High Temperature Tests

20030065899 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, OH, USA
Altitude-Wind-Tunnel Investigation of Performance of Several Propellers on YP-47M Airplane at High Blade Loadings, 6, Hamilton Standard 6507A-2 Four- and Three-Blade Propellers
Saari, Martin J.; Sorin, Solomon M.; December 19, 1946; 57 pp.; In English
Report No.(s): NACA-RM-E6K26; No Copyright; Avail: CASI; A04, Hardcopy

An altitude-wind-tunnel investigation has been made to determine the performance of Hamilton Standard 6507A-2 four-blade and three-blade propellers on a YP-47M airplane at high blade loadings and high engine powers. Characteristics of the four-blase propeller were obtained for a range of power coefficients from 0.10 to 1.00 at free-stream Mach numbers of 0.20, 0.30, 0.40. Characteristics of the three-blade propeller were obtained for a range of power coefficients from 0.30 to 1.00 at a free-stream Mach number of 0.40. Results of the force measurements indicate primarily the trend of propeller efficiency for changes in power coefficient or advance-diameter ratio because no corrections for the effects of tunnel-wall constriction on the installation were applied. Slipstream surveys are presented to illustrate blade thrust load distribution for certain operating conditions. Within the range of advance-diameter ratios investigated at each free-stream Mach number, the efficiency of the four-blade propeller decreased as the power coefficient was increased from 0.10 to 1.00. For the three-blade propeller, nearly constant maximum efficiencies were obtained for power coefficients from 0.32 to 0.63 at advance-diameter ratios between 1.90 and 3.00. In general, for conditions below the stall and critical tip Mach number, the maximum thrust load shifted from the inboard sections toward the tip sections as the power coefficient was increased or as the advance-diameter ratio was decreased. For conditions beyond the stall or critical tip Mach number, losses in thrust occurred on the outboard blade sections owing to flow break-down; the thrust load increased slightly on the inboard sections.
Author
Wind Tunnel Tests; Propeller Efficiency; Propellers; Thrust Loads; Load Distribution (Forces); Propeller Blades

20030065913 NASA Langley Research Center, Hampton, VA, USA
Rotor Wake Vortex Definition Using 3C-PIV Measurements: Corrected for Vortex Orientation
Burley, Casey L.; Brooks, Thomas F.; vanderWall, Berend; Richard, Hughues Richard; Raffel, Markus; Beaumier, Philippe; Delrieux, Yves; Lim, Joon W.; Yu, Yung H.; Tung, Chee, et al.; [2003]; 19 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference, 12-14 May 2003, Hilton Head, SC, USA
Report No.(s): AIAA Paper 2003-3175; Copyright; Avail: CASI; A03, Hardcopy

Three-component (3-C) particle image velocimetry (PIV) measurements, within the wake across a rotor disk plane, are used to determine wake vortex definitions important for BVI (Blade Vortex Interaction) and broadband noise prediction. This study is part of the HART II test program conducted using a 40 percent scale BO-105 helicopter main rotor in the German-Dutch Wind Tunnel (DNW). In this paper, measurements are presented of the wake vortex field over the advancing side of the rotor operating at a typical descent landing condition. The orientations of the vortex (tube) axes are found to have non-zero tilt angles with respect to the chosen PIV measurement cut planes, often on the order of 45 degrees. Methods for determining the orientation of the vortex axis and reorienting the measured PIV velocity maps (by rotation/projection) are presented. One method utilizes the vortex core axial velocity component, the other utilizes the swirl velocity components. Key vortex parameters such as vortex core size, strength, and core velocity distribution characteristics are determined from the reoriented PIV velocity maps. The results are compared with those determined from velocity maps that are not corrected for orientation. Knowledge of magnitudes and directions of the vortex axial and swirl velocity components as a function of streamwise location provide a basis for insight into the vortex evolution.
Author
Noise Prediction; Vortices; Rotary Wings; Helicopters

20030065915 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
On Landing Gear Stresses
Gentric, A.; Sur les Sollicitations des Atterrisseurs; July 1956, No. 25, pp. 17-38; In English
Report No.(s): NACA-TM-1422; No Copyright; Avail: CASI; A03, Hardcopy

Information on landing gear stresses is presented on the following: vibratory phenomena, tangential forces applied to landing gear, fore and aft oscillations of landing gears, examples of fatigue failures, vibration calculations, and improvement of existing test equipment.
CASI
Landing Gear; Failure; Vibrational Stress

20030065918 NASA Langley Research Center, Hampton, VA, USA

Analysis and Test Correlation of Proof of Concept Box for Blended Wing Body-Low Speed Vehicle

Spellman, Regina L.; [2003]; 10 pp.; In English; NAFEMS World Congress 2003, 27-31 May 2003, Orlando, FL, USA; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The Low Speed Vehicle (LSV) is a 14.2% scale remotely piloted vehicle of the revolutionary Blended Wing Body concept. The design of the LSV includes an all composite airframe. Due to internal manufacturing capability restrictions, room temperature layups were necessary. An extensive materials testing and manufacturing process development effort was underwent to establish a process that would achieve the high modulus/low weight properties required to meet the design requirements. The analysis process involved a loads development effort that incorporated aero loads to determine internal forces that could be applied to a traditional FEM of the vehicle and to conduct detailed component analyses. A new tool, Hypersizer, was added to the design process to address various composite failure modes and to optimize the skin panel thickness of the upper and lower skins for the vehicle. The analysis required an iterative approach as material properties were continually changing. As a part of the material characterization effort, test articles, including a proof of concept wing box and a full-scale wing, were fabricated. The proof of concept box was fabricated based on very preliminary material studies and tested in bending, torsion, and shear. The box was then tested to failure under shear. The proof of concept box was also analyzed using Nastran and Hypersizer. The results of both analyses were scaled to determine the predicted failure load. The test results were compared to both the Nastran and Hypersizer analytical predictions. The actual failure occurred at 899 lbs. The failure was predicted at 1167 lbs based on the Nastran analysis. The Hypersizer analysis predicted a lower failure load of 960 lbs. The Nastran analysis alone was not sufficient to predict the failure load because it does not identify local composite failure modes. This analysis has traditionally been done using closed form solutions. Although Hypersizer is typically used as an optimizer for the design process, the failure prediction was used to help gain acceptance and confidence in this new tool. The correlated models and process were to be used to analyze the full BWB-LSV airframe design. The analysis and correlation with test results of the proof of concept box is presented here, including the comparison of the Nastran and Hypersizer results. Author

Blended-Wing-Body Configurations; Failure Modes; Airframes; Woven Composites; Remotely Piloted Vehicles

20030065929 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, OH, USA

Preliminary Results of an Altitude-Wind-Tunnel Investigation of an Axial-Flow Gas Turbine-Propeller Engine, 4, Compressor and Turbine Performance Characteristics

Wallner, Lewis E.; Saari, Martin J.; August 10, 1948; 44 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-RM-E8F10c; No Copyright; Avail: CASI; A03, Hardcopy

As part of an investigation of the performance and operational characteristics of the axial-flow gas turbine-propeller engine, conducted in the Cleveland altitude wind tunnel, the performance characteristics of the compressor and the turbine were obtained. The data presented were obtained at a compressor-inlet ram-pressure ratio of 1.00 for altitudes from 5000 to 35,000 feet, engine speeds from 8000 to 13,000 rpm, and turbine-inlet temperatures from 1400 to 2100 R. The highest compressor pressure ratio obtained was 6.15 at a corrected air flow of 23.7 pounds per second and a corrected turbine-inlet temperature of 2475 R. Peak adiabatic compressor efficiencies of about 77 percent were obtained near the value of corrected air flow corresponding to a corrected engine speed of 13,000 rpm. This maximum efficiency may be somewhat low, however, because of dirt accumulations on the compressor blades. A maximum adiabatic turbine efficiency of 81.5 percent was obtained at rated engine speed for all altitudes and turbine-inlet temperatures investigated.
Author

Altitude Tests; Wind Tunnel Tests; Axial Flow Turbines; Gas Turbine Engines; Propellers; Compressor Efficiency

20030065994 Tuskegee Inst., AL, USA

Effects of Self-Instructional Methods and Above Real Time Training (ARTT) for Maneuvering Tasks on a Flight Simulator

Norlin, Ken, Technical Monitor; Ali, Syed Firasat; Khan, M. Javed; Rossi, Marcia J.; Crane, Peter; Heath, Bruce E.; Knighten, Tremaine; Culpepper, Christi; August 2003; 30 pp.; In English
Contract(s)/Grant(s): NAG4-209; No Copyright; Avail: CASI; A03, Hardcopy

Personal computer based flight simulators are expanding opportunities for providing low-cost pilot training. One advantage of these devices is the opportunity to incorporate instructional features into training scenarios that might not be cost effective with earlier systems. Research was conducted to evaluate the utility of different instructional features using a coordinated level turn as an aircraft maneuvering task. In study I, a comparison was made between automated computer grades of performance with certified flight instructors grades. Every one of the six student volunteers conducted a flight with level

turns at two different bank angles. The automated computer grades were based on prescribed tolerances on bank angle, airspeed and altitude. Two certified flight instructors independently examined the video tapes of heads up and instrument displays of the flights and graded them. The comparison of automated grades with the instructors grades ms based on correlations between them. In study II, a 2x2 between subjects factorial design was used to devise and conduct an experiment. Comparison was made between real time training and above real time training and between feedback and no feedback in training. The performance measure to monitor progress in training was based on deviations in bank angle and altitude. The performance measure was developed after completion of the experiment including the training and test flights. It was not envisaged before the experiment. The experiment did not include self-instructions as it was originally planned, although feedback by experimenter to the trainee was included in the study.
Author
Aircraft Maneuvers; Flight Simulators; Pilot Training; Real Time Operation; Methodology; Automatic Control; Maneuvers

20030066110 Purdue Univ., West Lafayette, IN, USA
Main Chamber Injectors For Advanced Hydrocarbon Booster Engines
Long, Matthew R.; Bazarov, Vladimir G.; Anderson, William E.; July 22, 2003; 14 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAG8-1894
Report No.(s): AIAA Paper 2003-4599; No Copyright; Avail: CASI; A03, Hardcopy

Achieving the highest possible specific impulse has long been a key driver for space launch systems. Recently, more importance has been placed on the need for increased reliability and streamlined launch operations. These general factors along with more specific mission requirements have provided a new focus that is centered on the oxidizer rich staged combustion (ORSC) cycle. Despite a history of use in Russia that extends back to the 1960's, a proven design methodology for ORSC cycle engines does not exist in the West. This lack of design expertise extends to the main chamber injector, a critical subcomponent that largely determines the engine performance and main chamber life. The goals of the effort described here are to establish an empirical knowledge base to provide a fundamental understanding of main chamber injectors and for verification of an injector design methodology for the ORSC cycle. The design of a baseline injector element, derived from information on Russian engines in the open literature, is presented. The baseline injector comprises a gaseous oxidizer core flow and an annular swirling fuel flow. Sets of equations describing the steady-state and the dynamic characteristics of the injector are presented; these equations, which form the basis of the design analysis methodology, will be verified in tests later this year. On-going cold flow studies, using nitrogen and water as simulants, are described which indicate highly atomized and symmetric sprays.
Author
Booster Rocket Engines; Hydrocarbons; Injectors; Combustion Chambers; Design Analysis

20030066111 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Investigation of Dive Brakes and a Dive-Recovery Flap on a High-Aspect-Ratio Wing in the Langley 8-Foot High-Speed Tunnel
Mattson, Axel T.; August 28, 1946; 121 pp.; In English
Report No.(s): NACA-RM-L6H28c; No Copyright; Avail: CASI; A06, Hardcopy

The results of tests made to determine the aerodynamic characteristics of a solid brake, a slotted brake, and a dive-recovery flap mounted on a high aspect ratio wing at high Mach numbers are presented. The data were obtained in the Langley 8-foot high-speed tunnel for corrected Mach numbers up to 0.940. The results have been analyzed with regard to the suitability of dive-control devices for a proposed high-speed airplane in limiting the airplane terminal Mach number by the use of dive brakes and in achieving favorable dive-recovery characteristics by the use of a dive-recovery flap. The analysis of the results indicated that the slotted brake would limit the proposed airplane terminal Mach number to values below 0.880 for altitudes up to 35,000 feet and a wing loading of 80 pounds per square foot and the dive-recovery flap would produce trim changes required for controlled pull-outs at 25,000 feet for a Mach number range from 0.800 to 0.900. Basic changes in spanwise loading are presented to aid in the evaluation of the wing strength requirements.
Author
Wind Tunnel Tests; Aerodynamic Brakes; Flaps (Control Surfaces); Slender Wings

20030066137 NASA Marshall Space Flight Center, Huntsville, AL, USA

Development of the Next Generation Gas Trap for the Space Station Internal Thermal Control System

Holt, James M.; Leimkuehler, Thomas O.; Spelbring, Chris; Reeves, Daniel R.; [2003]; 11 pp.; In English; 2003 International Conference on Environmental Systems (ICES) 33rd Annual Meeting, 7-10 Jul. 2003, Vancouver, BC, Canada; Original contains black and white illustrations

Report No.(s): SAE-2003-01-2566; Copyright; Avail: Other Sources

The current dual-membrane gas trap is designed to remove non-condensed gases (NCG) from the Internal Thermal Control System (ITCS) coolant on board the International Space Station (ISS). To date it has successfully served its purpose of preventing depriming, overspeed, and shutdown of the ITCS pump. However, contamination in the ITCS coolant has adversely affected the gas venting rate and lifetime of the gas trap, warranting a development effort for a next-generation gas trap. Design goals are to meet or exceed the current requirements to (1) include greater operating ranges and conditions, (2) eliminate reliance on the current hydrophilic tube fabrication process, and (3) increase operational life and tolerance to particulate and microbial growth fouling. In addition, the next generation gas trap will essentially be a 'dropin' design such that no modifications to the ITCS pump package assembly (PPA) will be required, and the implementation of the new design will not affect changes to the ITCS operational conditions, interfaces, or software. This paper will present the initial membrane module design and development work which has included (1) a trade study among several conceptual designs, (2) performance modeling of a hydrophobic-only design, and (3) small-scale development test data for the hydrophobic-only design. Testing has shown that the hydrophobic-only design is capable of performing even better than the current dual-membrane design for both steady-state gas removal and gas slug removal.

Author

Temperature Control; Hydrophobicity; International Space Station; Fabrication; Mathematical Models; Gas Pipes

20030066156 NASA Langley Research Center, Hampton, VA, USA

Robust Airfoil Optimization in High Resolution Design Space

Li, Wu; Padula, Sharon L.; [2003]; 6 pp.; In English; 5th World Congress of Structural Multidisciplinary Optimization, 19-23 May 2003, Venice, Italy; No Copyright; Avail: CASI; A02, Hardcopy

The robust airfoil shape optimization is a direct method for drag reduction over a given range of operating conditions and has three advantages: (1) it prevents severe degradation in the off-design performance by using a smart descent direction in each optimization iteration, (2) it uses a large number of B-spline control points as design variables yet the resulting airfoil shape is fairly smooth, and (3) it allows the user to make a trade-off between the level of optimization and the amount of computing time consumed. The robust optimization method is demonstrated by solving a lift-constrained drag minimization problem for a two-dimensional airfoil in viscous flow with a large number of geometric design variables. Our experience with robust optimization indicates that our strategy produces reasonable airfoil shapes that are similar to the original airfoils, but these new shapes provide drag reduction over the specified range of Mach numbers. We have tested this strategy on a number of advanced airfoil models produced by knowledgeable aerodynamic design team members and found that our strategy produces airfoils better or equal to any designs produced by traditional design methods.

Author

Airfoils; High Resolution; Shape Optimization; Computational Fluid Dynamics; Robustness (Mathematics); Mathematical Models

20030066161 Old Dominion Univ., Norfolk, VA, USA

Residual Strength Analyses of Monolithic Structures

Forth, Scott, Technical Monitor; Ambur, Damodar R., Technical Monitor; Seshadri, B. R.; Tiwari, S. N.; June 2003; 23 pp.; In English

Contract(s)/Grant(s): NCC1-371; ODURF Proj. 102051; No Copyright; Avail: CASI; A03, Hardcopy

Finite-element fracture simulation methodology predicts the residual strength of damaged aircraft structures. The methodology uses the critical crack-tip-opening-angle (CTOA) fracture criterion to characterize the fracture behavior of the material. The CTOA fracture criterion assumes that stable crack growth occurs when the crack-tip angle reaches a constant critical value. The use of the CTOA criterion requires an elastic- plastic, finite-element analysis. The critical CTOA value is determined by simulating fracture behavior in laboratory specimens, such as a compact specimen, to obtain the angle that best fits the observed test behavior. The critical CTOA value appears to be independent of loading, crack length, and in-plane dimensions. However, it is a function of material thickness and local crack-front constraint. Modeling the local constraint requires either a three-dimensional analysis or a two-dimensional analysis with an approximation to account for the constraint effects. In recent times as the aircraft industry is leaning towards monolithic structures with the intention of reducing part count

and manufacturing cost, there has been a consistent effort at NASA Langley to extend critical CTOA based numerical methodology in the analysis of integrally-stiffened panels.In this regard, a series of fracture tests were conducted on both flat and curved aluminum alloy integrally-stiffened panels. These flat panels were subjected to uniaxial tension and during the test, applied load-crack extension, out-of-plane displacements and local deformations around the crack tip region were measured. Compact and middle-crack tension specimens were tested to determine the critical angle (wc) using three-dimensional code (ZIP3D) and the plane-strain core height (hJ using two-dimensional code (STAGS). These values were then used in the STAGS analysis to predict the fracture behavior of the integrally-stiffened panels. The analyses modeled stable tearing, buckling, and crack branching at the integral stiffener using different values of critical CTOA for different material thicknesses and orientation. Comparisons were made between measured and predicted load-crack extension, out-of-plane displacements and local deformations around the crack tip region. Simultaneously, three-dimensional capabilities to model crack branching and to monitor stable crack growth of multiple cracks in a large thick integrally-stiffened flat panels were implemented in three-dimensional finite element code (ZIP3D) and tested by analyzing the integrally-stiffened panels tested at Alcoa. The residual strength of the panels predicted from STAGS and ZP3D code compared very well with experimental data. In recent times, STAGS software has been updated with new features and now one can have combinations of solid and shell elements in the residual strength analysis of integrally-stiffened panels.
Author
Aircraft Structures; Aluminum Alloys; Fracture Mechanics; Residual Strength; Crack Propagation; Structural Design

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*.

20030065613 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Structurally Integrated Antennas on a Joined-Wing Aircraft
Smallwood, Ben P.; Mar. 2003; 88 pp.; In English
Report No.(s): AD-A412866; AFIT/GAE/ENY/03-7; No Copyright; Avail: CASI; A05, Hardcopy

This research is a foundational study of conformal, load-bearing antenna arrays embedded into the wing structure of a joined-wing aircraft. It is a muiltidisciplinary effort that touches on the aerodynamic structural and electromagnetic design considerations that stem from this unique type of sensor integration. The antenna performance Finite Element Model (FEM) and control surface effectiveness are investigated. The theory describing an ensemble of dipole antenna elements that conform to the shape of a section of the joined wing is developed. The far held flee space radiation pattern of the sensor is then analyzed for a wing that is deflected due to typical aerodynamic loading. This pattern is compared to the same antenna when the wing is not deformed. A FEM of the antenna elements is created and incorporated into the hill FEM of the joined-wing aircraft allowing its structural impact to be realized. Based on the positioning of these large sensor arrays control surfaces are placed and examined to achieve the proper handling capabilities necessary for this type of aircraft.
DTIC
Aircraft Antennas; Antenna Arrays

07
AIRCRAFT PROPULSION AND POWER

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

20030065624 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, OH, USA
Preliminary Results of an Altitude-Wind-Tunnel Investigation of a TG-100A Gas Turbine-Propeller Engine II - Windmilling Characteristics
Conrad, E. W.; Durham, J. D.; August 4, 1947; 54 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-RM-E7G25; No Copyright; Avail: CASI; A04, Hardcopy

An investigation was conducted to determine the operational and performance characteristics of the TG-100A gas turbine-propeller engine II. Windmilling characteristics were deterined for a range of altitudes from 5000 to 35,000 feet, true

airspeeds from 100 to 273 miles per hour, and propeller blade angles from 4 degrees to 46 degrees.
Author
Gas Turbine Engines; Propeller Blades; Wind Tunnel Tests; Autorotation

20030065842 NASA Marshall Space Flight Center, Huntsville, AL, USA
Parametic Uncertainty Analysis Study to Provide RBCC Testing Guidelines
Law, Boon-Chuan; Hudson, Susan T.; Steele, W. Glenn; Buzzell, James C.; Hughes, Mark S.; July 21, 2003; 38 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS13-98033
Report No.(s): AIAA Paper 2003-5234; Copyright; Avail: Other Sources

Combined-cycle propulsion technology is a strong candidate for meeting NASA space transportation goals. Extensive ground testing of integrated air-breathing/rocket systems across all propulsion operational modes will be needed to demonstrate this propulsion technology. To realize the greatest benefit of Rocket-Based Combined Cycle (RBCC) engine testing, uncertainty analyses are required. General uncertainty analysis was used to evaluate the performance of a RBCC engine system in this study. The desired test results of interest included specific impulse and characteristic velocity. Five methods of determining specific impulse were evaluated. Theoretical and actual characteristic velocities were analyzed to evaluate C* efficiency. Initially, general uncertainty analyses were completed relative to 1% accuracy for each measured variable. Then, cases were run using more realistic uncertainty estimates. The relative contributions of the different variables' uncertainties to the overall uncertainty of the selected performance parameters were also calculated. This process helps to identify the critical measurements from an uncertainty standpoint and can be a significant guide in the cost effective use of resources to reduce the test uncertainty.
Author
Engine Tests; NASA Programs; Rocket-Based Combined-Cycle Engines; Propulsion System Performance; Technology Utilization

20030065902 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, OH, USA
Preliminary Results of an Altitude-Wind-Tunnel Investigation of an Axial-Flow Gas Turbine-Propeller Engine, 3, Pressure and Temperature Distributions
Geisenheyner, Robert M.; Berdysz, Joseph J.; August 02, 1948; 69 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-RM-E8F10b; No Copyright; Avail: CASI; A04, Hardcopy

Performance properties and operational characteristics of an axial-flow gas turbine-propeller engine were determined. Data are presented for a range of simulated altitudes from 5,000 to 35,0000 feet, compressor inlet- ram pressure ratios from 1.00 to 1.17, and engine speeds from 8000 to 13,000 rpm.
CASI
Axial Flow Turbines; Gas Turbine Engines; Inlet Pressure; Propeller Efficiency; Wind Tunnel Tests

20030065943 General Electric Aircraft Engines, Cincinnati, OH, USA
Propulsion Health Monitoring for Enhanced Safety
Butz, Mark G.; Rodriguez, Hector M.; June 2003; 79 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-99203; WBS-22-708-30-05
Report No.(s): NASA/CR-2003-212291; NAS 1.26:212291; E-13853; Copyright; Avail: CASI; A05, Hardcopy

This report presents the results of the NASA contract Propulsion System Health Management for Enhanced Safety performed by General Electric Aircraft Engines (GE AE), General Electric Global Research (GE GR), and Pennsylvania State University Applied Research Laboratory (PSU ARL) under the NASA Aviation Safety Program. This activity supports the overall goal of enhanced civil aviation safety through a reduction in the occurrence of safety-significant propulsion system malfunctions. Specific objectives are to develop and demonstrate vibration diagnostics techniques for the on-line detection of turbine rotor disk cracks, and model-based fault tolerant control techniques for the prevention and mitigation of in-flight engine shutdown, surge/stall, and flameout events. The disk crack detection work was performed by GE GR which focused on a radial-mode vibration monitoring technique, and PSU ARL which focused on a torsional-mode vibration monitoring technique. GE AE performed the Model-Based Fault Tolerant Control work which focused on the development of analytical techniques for detecting, isolating, and accommodating gas-path faults.
Author
Aircraft Engines; Aircraft Safety; Systems Health Monitoring; Civil Aviation; Propulsion System Performance; Systems Engineering

20030065947 QSS Group, Inc., Cleveland, OH, USA

Application of a Split-Fiber Probe to Velocity Measurement in the NASA Research Compressor

Lepicovsky, Jan; June 2003; 16 pp.; In English; 2003 Fluids Engineering Division Summer Meeting, 6-10 Jul. 2003, Honolulu, HI, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS3-00145; WBS-22-708-28-03

Report No.(s): NASA/CR-2003-212489; NAS 1.26:212489; E-14034; FEDSM2003-45607; No Copyright; Avail: CASI; A03, Hardcopy

A split-fiber probe was used to acquire unsteady data in a research compressor. The probe has two thin films deposited on a quartz cylinder 200 microns in diameter. A split-fiber probe allows simultaneous measurement of velocity magnitude and direction in a plane that is perpendicular to the sensing cylinder, because it has its circumference divided into two independent parts. Local heat transfer considerations indicated that the probe direction characteristic is linear in the range of flow incidence angles of +/- 35. Calibration tests confirmed this assumption. Of course, the velocity characteristic is nonlinear as is typical in thermal anemometry. The probe was used extensively in the NASA Glenn Research Center (GRC) low-speed, multistage axial compressor, and worked reliably during a test program of several months duration. The velocity and direction characteristics of the probe showed only minute changes during the entire test program. An algorithm was developed to decompose the probe signals into velocity magnitude and velocity direction. The averaged unsteady data were compared with data acquired by pneumatic probes. An overall excellent agreement between the averaged data acquired by a split-fiber probe and a pneumatic probe boosts confidence in the reliability of the unsteady content of the split-fiber probe data. To investigate the features of unsteady data, two methods were used: ensemble averaging and frequency analysis. The velocity distribution in a rotor blade passage was retrieved using the ensemble averaging method. Frequencies of excitation forces that may contribute to high cycle fatigue problems were identified by applying a fast Fourier transform to the absolute velocity data. Author

Velocity Measurement; Pneumatic Probes; Turbocompressors; Heat Transfer; Incidence; Calibrating; Velocity Distribution; Unsteady Flow

20030065966 NASA Glenn Research Center, Cleveland, OH, USA

Foreign Object Damage in Disks of Two Gas-Turbine-Grade Silicon Nitrides by Steel Ball Projectiles at Ambient Temperature

Choi, Sung R.; Pereira, J. Michael; Janosik, Lesley A.; Bhatt, Ramakrishna T.; July 2003; 38 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 22-708-31-07

Report No.(s): NASA/TM-2003-212224; E-13844; NAS 1.15:212224; Copyright; Avail: CASI; A03, Hardcopy

Foreign object damage (FOD) behavior of two commercial gas-turbine-grade silicon nitrides, AS800 and SN282, was determined at ambient temperature through postimpact strength testing of disks impacted by steel ball projectiles with a diameter of 1.59 mm in a velocity range from 115 to 440 m/s. AS800 silicon nitride exhibited a greater FOD resistance than SN282, primarily due to its greater value of fracture toughness (k(sub Ic)). The critical impact velocity V(sub c) for which the corresponding postimpact strength was the lowest was V(sub c) approximately equal to 440 and 300 m/s AS800 and SN282, respectively. A unique lower strength regime was typified for both silicon nitrides depending on impact velocity and was attributed to significant radial cracking. The damage generated by projectile impact was typically in the form of ring, radial, and cone cracks with their severity and combination being dependent on impact velocity. Unlike the thick (4 millimeters) flexure bar specimens used in our previous studies, the thin (2 millimeter) disk target specimen exhibited a unique back-side radial cracking on the reverse side just beneath the impact sites at and above impact velocities of 160 meters per second for SN282 and 220 meters per second AS800.

Author

Ambient Temperature; Gas Turbines; Impact Damage; Projectiles; Silicon Nitrides; Mechanical Properties; Impact Tests; Steels

20030066104 NASA Glenn Research Center, Cleveland, OH, USA

Optimal Area Profiles for Ideal Single Nozzle Air-Breathing Pulse Detonation Engines

Paxson, Daniel E.; July 2003; 18 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color illustrations

Report No.(s): NASA/TM-2003-212496; AIAA Paper 2003-4512; NAS 1.15:212496; E-14057; No Copyright; Avail: CASI; A03, Hardcopy

The effects of cross-sectional area variation on idealized Pulse Detonation Engine performance are examined numerically.

A quasi-one-dimensional, reacting, numerical code is used as the kernel of an algorithm that iteratively determines the correct sequencing of inlet air, inlet fuel, detonation initiation, and cycle time to achieve a limit cycle with specified fuel fraction, and volumetric purge fraction. The algorithm is exercised on a tube with a cross sectional area profile containing two degrees of freedom: overall exit-to-inlet area ratio, and the distance along the tube at which continuous transition from inlet to exit area begins. These two parameters are varied over three flight conditions (defined by inlet total temperature, inlet total pressure and ambient static pressure) and the performance is compared to a straight tube. It is shown that compared to straight tubes, increases of 20 to 35 percent in specific impulse and specific thrust are obtained with tubes of relatively modest area change. The iterative algorithm is described, and its limitations are noted and discussed. Optimized results are presented showing performance measurements, wave diagrams, and area profiles. Suggestions for future investigation are also discussed.
Author
Air Breathing Engines; Pulse Detonation Engines; Nozzle Design; Iteration; Algorithms; Optimization; Intake Systems

20030066157 Zentrale fuer Wissenschaftliches Berichtswesen, Berlin, Germany
Temperatures and Stresses on Hollow Blades For Gas Turbines
Pollmann, Erich; Zentrale fuer Wissenschaftliches Berichtswesen der Luftfahrtforschung des Generalluftzeugmeisters Berlin-Adlershof; September 1947; 111 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-TM-1183; Forschungsbericht-1879; No Copyright; Avail: CASI; A06, Hardcopy

The present treatise reports on theoretical investigations and test-stand measurements which were carried out in the BMW Flugmotoren GMbH in developing the hollow blade for exhaust gas turbines. As an introduction the temperature variation and the stress on a turbine blade for a gas temperature of 900 degrees and circumferential velocities of 600 meters per second are discussed. The assumptions onthe heat transfer coefficients at the blade profile are supported by tests on an electrically heated blade model. The temperature distribution in the cross section of a blade Is thoroughly investigated and the temperature field determined for a special case. A method for calculation of the thermal stresses in turbine blades for a given temperature distribution is indicated. The effect of the heat radiation on the blade temperature also is dealt with. Test-stand experiments on turbine blades are evaluated, particularly with respect to temperature distribution in the cross section; maximum and minimum temperature in the cross section are ascertained. Finally, the application of the hollow blade for a stationary gas turbine is investigated. Starting from a setup for 550 C gas temperature the improvement of the thermal efficiency and the fuel consumption are considered as well as the increase of the useful power by use of high temperatures. The power required for blade cooling is taken into account.
Author
Turbine Blades; Gas Turbines; Thermal Stresses; Thermodynamic Efficiency

08
AIRCRAFT STABILITY AND CONTROL

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

20030065850 NASA Ames Research Center, Moffett Field, CA, USA
Control Reallocation Strategies for Damage Adaptation in Transport Class Aircraft
Gundy-Burlet, Karen; Krishnakumar, K.; Limes, Greg; Bryant, Don; June 03, 2003; 7 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): 704-01-32; Copyright; Avail: CASI; A02, Hardcopy

This paper examines the feasibility, potential benefits and implementation issues associated with retrofitting a neural-adaptive flight control system (NFCS) to existing transport aircraft, including both cable/hydraulic and fly-by-wire configurations. NFCS uses a neural network based direct adaptive control approach for applying alternate sources of control authority in the presence of damage or failures in order to achieve desired flight control performance. Neural networks are used to provide consistent handling qualities across flight conditions, adapt to changes in aircraft dynamics and to make the controller easy to apply when implemented on different aircraft. Full-motion piloted simulation studies were performed on two different transport models: the Boeing 747-400 and the Boeing C-17. Subjects included NASA, Air Force and commercial airline pilots. Results demonstrate the potential for improving handing qualities and significantly increased survivability rates under various simulated failure conditions.
Author
Boeing 747 Aircraft; Neural Nets; Controllability; Retrofitting; Flight Control

20030065888 NASA Ames Research Center, Moffett Field, CA, USA

Neural Network Based Modeling and Analysis of LP Control Surface Allocation

Langari, Reza; Krishnakumar, Kalmanje; Gundy-Burlet, Karen; May 29, 2003; 8 pp.; In English; AIAA GNC Conference, 11-14 Aug. 2003, Austin, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

This paper presents an approach to interpretive modeling of LP based control allocation in intelligent flight control. The emphasis is placed on a nonlinear interpretation of the LP allocation process as a static map to support analytical study of the resulting closed loop system, albeit in approximate form. The approach makes use of a bi-layer neural network to capture the essential functioning of the LP allocation process. It is further shown via Lyapunov based analysis that under certain relatively mild conditions the resulting closed loop system is stable. Some preliminary conclusions from a study at Ames are stated and directions for further research are given at the conclusion of the paper.

Author

Flight Management Systems; Adaptive Control; Feedback Control; Neural Nets; Man Machine Systems

20030066166 NASA Ames Research Center, Moffett Field, CA, USA

An Adaptive Critic Approach to Reference Model Adaptation

Krishnakumar, K.; Limes, G.; Gundy-Burlet, K.; Bryant, D.; May 29, 2003; 6 pp.; In English; AIAA GNC Conference, 11-14 Aug. 2003, Austin, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

Neural networks have been successfully used for implementing control architectures for different applications. In this work, we examine a neural network augmented adaptive critic as a Level 2 intelligent controller for a C- 17 aircraft. This intelligent control architecture utilizes an adaptive critic to tune the parameters of a reference model, which is then used to define the angular rate command for a Level 1 intelligent controller. The present architecture is implemented on a high-fidelity non-linear model of a C-17 aircraft. The goal of this research is to improve the performance of the C-17 under degraded conditions such as control failures and battle damage. Pilot ratings using a motion based simulation facility are included in this paper. The benefits of using an adaptive critic are documented using time response comparisons for severe damage situations.

Author

C-17 Aircraft; Neural Nets; Automatic Flight Control

09
RESEARCH AND SUPPORT FACILITIES (AIR)

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

20030065605 Air Force Research Lab., Tyndall AFB, FL

NoFoam Unit Installation, Evaluation and Operations Manual

Fischer, William; Kalberer, Jennifer; Mar. 10, 2003; 64 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414039; AFRL-ML-TY-TR-2003-4531; No Copyright; Avail: CASI; A04, Hardcopy

Naval Facilities Engineering Service Center requested the Air Force Research Laboratory (AFRL) Fire Research Group to conduct an independent installation and evaluation of the Universal Stationary/Mobile NoFoam Unit using AFRL vehicles and facilities. Currently, the majority of Fire Departments that use 3% Aqueous Film Forming Foam (AFFF) liquid concentrate in their fleet do not have the facilities available to conduct annual foam proportioning testing of their vehicles (National Fire Protection Association 1911, Section 3.1). The purpose of the NoFoam Unit is to replace the 3% AFFF liquid concentrate with an environmentally benign agent (water or dye-water) during foam operational testing. This project evaluated the operational performance of the NoFoam Unit on two independent P-19 ARFF vehicles. Twenty-seven tests were completed with Vehicle 1 and fifteen tests with Vehicle 2. The NoFoam Unit operated as designed during all testing and identified several mechanical problems with the handline and turret systems on the P-19s. The NoFoam Unit was easily adapted to the P-19, provided a reliable alternative to conducting standard testing of foam proportioning systems, and assisted in troubleshooting mechanical problems with the handline/turret systems. This report contains information on the installation, evaluation, and operational manual for the NoFoam Unit.

DTIC

Installation Manuals; Fire Prevention; Flame Retardants; Rescue Operations

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*.

20030065735 Army War Coll., Carlisle Barracks, PA
Allocation of Army Resources to the Space Mission Area
Rayermann, Patrick H.; Apr. 7, 2003; 61 pp.; In English
Report No.(s): AD-A414191; No Copyright; Avail: CASI; A04, Hardcopy

The Department of Defense's Space Policy, Joint Publication 3-14, Joint Doctrine for Space Operations, and other sources make clear the importance of space and space forces to current and future US military operations. Throughout these documents and discussions, the joint nature of space operations is made clear, to include its recent reaffirmation by the transfer of the military space portfolio and the associated components from all of the services to the new US Strategic Command. In order to fulfill its assigned responsibilities and to properly address its interests in space systems, capabilities and exploitation, the Army must train soldiers with the right skills, assign them to the right organizations and have properly constituted and vigorous organizations whose missions incorporate space-related responsibilities. This paper will examine the current and future missions and interests of the Army with respect to space capabilities. It will then examine the skill sets, personnel assignments and organizations that are and will be required to meet the Army's needs for space capabilities from the perspectives of doctrine, training and organization. It compares current organizations with those that arise from its analysis and presents recommendations for addressing those discrepancies that it identifies.
DTIC
Aerospace Systems; Space Missions; Defense Program; Military Operations

20030065940 NASA Marshall Space Flight Center, Huntsville, AL, USA
COBRA System Engineering Processes to Achieve SLI Strategic Goals
Ballard, Richard O.; July 2003; 7 pp.; In English; AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-01108
Report No.(s): AIAA Paper 2003-4603; No Copyright; Avail: CASI; A02, Hardcopy

The COBRA Prototype Main Engine Development Project was an endeavor conducted as a joint venture between Pratt & Whitney and Aerojet to conduct risk reduction in LOX/LH2 main engine technology for the NASA Space Launch Initiative (SLI). During the seventeen months of the project (April 2001 to September 2002), approximately seventy reviews were conducted, beginning with the Engine Systems Requirements Review (SRR) and ending with the Engine Systems Interim Design Review (IDR). This paper discusses some of the system engineering practices used to support the reviews and the overall engine development effort.
Author
Hydrogen Oxygen Engines; Systems Engineering; Engine Design

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*.

20030065647 Texas A&M Univ., College Station, TX, USA
Analysis and Distributed Control of a Formation of Intelligent Satellites
Alfriend, K. T.; Vadali, S. R.; Apr. 28, 2003; 7 pp.; In English
Contract(s)/Grant(s): F49620-01-1-0518
Report No.(s): AD-A414012; AFRL-SR-AR-TR-03-0183; No Copyright; Avail: CASI; A02, Hardcopy

Perturbation based methods for determining initial conditions and shaping satellite formations to accommodate nonlinearity of the differential gravitational acceleration as well as eccentricity of the reference orbit have been developed. Control laws for formation maintenance as well as reconfiguration, valid for large formations and eccentric reference orbits have been developed via filter based LQR designs and period matching. An analytical solution to the relative motion problem

has been obtained by using a unit-sphere description of the motion. This approach converts the problem of formation control into an attitude control problem. A sub-optimal strategy for reconfiguring a formation using impulsive thrust has been developed that does not require any off-line optimization. The results of this approach have been compared with those obtained from numerical optimization. An analytical technique has also been developed for designing formations for large and high eccentricity relative orbits.
DTIC
Artificial Satellites; Perturbation Theory; Spacecraft Orbits; Satellite Design; Applications Of Mathematics

20030065717 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Experimental Demonstration of an Algorithm to Detect the Presence of a Parasitic Satellite
Dabrowski, Vincent J.; Mar. 2003; 117 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413233; AFIT/GAE/ENY/03-2; No Copyright; Avail: CASI; A06, Hardcopy

Published reports of microsatellite weapons testing have led to a concern that some of these 'parasitic' satellites could be deployed against US satellites to rendezvous dock and then disrupt, degrade disable or destroy the system. An effective detection method is essential. Various sensing solutions were investigated including visual, impact, and dynamic techniques. Dynamic detection, the most effective solution, was further explored. A detection algorithm was constructed and validated on the Air Force Institute of Technology's ground-based satellite simulator, SIMSAT. Results indicate that microsat microsatellites rigidly connected to a satellite can be detected with a series of small identical maneuvers utilizing data available today. All algorithm variations readily detected parasite-induced moment of inertia changes of 3-23%. The most accurate detection scheme. The most accurate detection scheme estimated the moment of inertia to 0.67%. The results look promising for sensing potential microsatellite threats to US systems. The detection scheme presented could easily be integrated into a complete space situational awareness system.
DTIC
Algorithms; Artificial Satellites; Microsatellites; System Identification

20030065754 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Optimal Replacement Policies for Satellite Constellations
Sumter, Bradley R.; Mar. 2003; 88 pp.; In English
Report No.(s): AD-A412905; AFIT/GOR/ENS/03-23; No Copyright; Avail: CASI; A05, Hardcopy

This work considers the problem of finding optimal replacement policies that minimize the expected total cost of maintaining a satellite constellation. The problem is modeled using discrete-time Markov decision processes to determine the replacement policy by allowing the satellite constellation to be in one of a finite number of states at each decision epoch. The constellation stochastically transitions at each time step from one state to another as determined by a set of transition probabilities. At each decision epoch, a decision maker chooses an action from a set of allowable actions for the current system state. A cost associated with each possible action is determined by the number of satellites purchased, launched, or held in storage, as well as the operational capability of the constellation. The system is evaluated for a given time horizon using the standard Policy Evaluation Algorithm of Markov decision processes (stochastic dynamic programming) to determine the optimal replacement policy and the minimum expected total cost. Example problems using notional data are presented to demonstrate the solution procedures. Sensitivity analysis of problem parameters is performed to investigate their impact on the minimum expected total cost of operating the constellation over a specified time horizon.
DTIC
Artificial Satellites; Markov Processes

20030065778 Parsons Engineering Science, Inc., Austin, TX, USA
Overview Environmental Assessment for the Space Based Infrared System (SBIRS)
Davis, Anthony C.; Koehler, Donald L.; Latimer, J. D.; McColloch, Craig; Reasons, David S.; Dec. 1996; 121 pp.; In English
Contract(s)/Grant(s): F41624-95-D-9018
Report No.(s): AD-A413834; No Copyright; Avail: CASI; A06, Hardcopy

The USA needs to procure a consolidated, cost-effective, flexible system that will meet the Nation's infrared space surveillance needs through the next two to three decades. The system must fulfill four broad mission areas: missile warning, missile defense, technical intelligence, and battlespace characterization. This overview Environmental Assessment (EA) identifies, describes, and evaluates the potential environmental impacts that could result from implementing the Space Based Infrared System (SBIRS) High Component, which is the development and testing of satellites for the geosynchronous orbit,

development and testing of infrared sensors for the highly elliptical orbit, design and testing of antennas for the overall SBIRS program, and Atlas IIAS or Evolved Expendable Launch Vehicle (EELV) operations at Cape Canaveral Air Station, Florida. The major impacts that were assessed were as follows: global impacts, which consist of launch vehicle impacts to the stratospheric ozone layer from rocket exhaust and deorbiting debris; and local impacts, which consist of launch clouds from the launch vehicles that will contain hydrochloric acid and aluminum oxide, electromagnetic radiation from antennas, and local spills from prelaunch activities. The EA evaluated how the Geosynchronous Earth Orbit Satellites and the launch vehicles would affect air quality, water resources, the water supply, cultural resources, biological resources, threatened and endangered species, and stratospheric ozone, and whether their use would result in environmental problems due to the creation of solid waste, hazardous materials, hazardous waste, nonionizing radiation, and noise. The EA also assessed how the SBIRS program would affect the environment of Cape Canaveral Air Station. The conclusion reached by this EA is that the SBIRS program will not produce significant environmental impacts, and an environmental impact statement is not required. (13 tables, 8 figures, 74 refs.)
DTIC
Antennas; Artificial Satellites; Launch Vehicles; Rocket Exhaust; Assessments; Environment Effects

20030065810 Air Force Research Lab., Wright-Patterson AFB, OH
Longitudinal Control and Footprint Analysis for a Reusable Military Launch Vehicle
Ngo, Anhtuan D.; Blake, William B.; Apr. 2003; 9 pp.; In English
Report No.(s): AD-A413829; AFRL-VA-WP-TP-2003-310; ASC-03-0811; No Copyright; Avail: CASI; A02, Hardcopy
In this paper, we will examine a configuration for a reusable military launch vehicle (RMLS) concept. This configuration allows for the vehicle to land in an inverted attitude. Such inverted landing improves the turnaround time of the vehicle by reducing the maintenance requirements of the vehicle's thermal protection system. An analysis is performed to examine the impacts by the configuration on stability, control, and footprint for an RMLS configuration.
DTIC
Reusable Launch Vehicles; Attitude Control; Launch Vehicle Configurations

20030065982 NASA Ames Research Center, Moffett Field, CA, USA
Web-based Weather Expert System (WES) for Space Shuttle Launch
Bardina, Jorge E.; Rajkumar, T.; [2003]; 6 pp.; In English; International Conference on Systems, Man and Cybernetics (SMC 2003}, 5-8 Oct. 2003, Washington, DC, USA; Copyright; Avail: CASI; A02, Hardcopy
The Web-based Weather Expert System (WES) is a critical module of the Virtual Test Bed development to support 'go/no go' decisions for Space Shuttle operations in the Intelligent Launch and Range Operations program of NASA. The weather rules characterize certain aspects of the environment related to the launching or landing site, the time of the day or night, the pad or runway conditions, the mission durations, the runway equipment and landing type. Expert system rules are derived from weather contingency rules, which were developed over years by NASA. Backward chaining, a goal-directed inference method is adopted, because a particular consequence or goal clause is evaluated first, and then chained backward through the rules. Once a rule is satisfied or true, then that particular rule is fired and the decision is expressed. The expert system is continuously verifying the rules against the past one-hour weather conditions and the decisions are made. The normal procedure of operations requires a formal pre-launch weather briefing held on Launch minus 1 day, which is a specific weather briefing for all areas of Space Shuttle launch operations. In this paper, the Web-based Weather Expert System of the Intelligent Launch and range Operations program is presented.
Author
Internet Resources; Weather Forecasting; Flight Conditions; Spacecraft Launching; Decision Support Systems

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*.

20030065617 Lockheed Martin Corp., Denver, CO, USA
Lockheed Martin Response to the OSP Challenge
Sullivan, Robert T.; Munkres, Randy; Megna, Thomas D.; Beckham, Joanne; June 25, 2003; 7 pp.; In English; International Air and Space Symposium and Exposition, 14-17 Jul. 2003, Dayton, OH, USA
Contract(s)/Grant(s): NAS8-01098
Report No.(s): AIAA Paper 2003-2708; No Copyright; Avail: CASI; A02, Hardcopy

The Lockheed Martin Orbital Space Plane System provides crew transfer and rescue for the International Space Station more safely and affordably than current human space transportation systems. Through planned upgrades and spiral development, it is also capable of satisfying the Nation's evolving space transportation requirements and enabling the national vision for human space flight. The OSP System, formulated through rigorous requirements definition and decomposition, consists of spacecraft and launch vehicle flight elements, ground processing facilities and existing transportation, launch complex, range, mission control, weather, navigation, communication and tracking infrastructure. The concept of operations, including procurement, mission planning, launch preparation, launch and mission operations and vehicle maintenance, repair and turnaround, is structured to maximize flexibility and mission availability and minimize program life cycle cost. The approach to human rating and crew safety utilizes simplicity, performance margin, redundancy, abort modes and escape modes to mitigate credible hazards that cannot be designed out of the system.
Author
Aerospace Planes; Launch Vehicles; Ground Support Systems; Spacecraft Launching; Navigation; Spacecraft Docking

20030066167 Columbia Accident Investigation Board, Arlington, VA, USA
Columbia Accident Investigation Board Report, Volume 1
Gehman, Harold W., Jr.; Barry, John L.; Deal, Duane W.; Hallock, James N.; Hess, Kenneth W.; Hubbard, G. Scott; Logsdon, John M.; Osheroff, Douglas D.; Ride, Sally T.; Tetrault, Roger E., et al.; August 2003; 248 pp.; In English; Original contains color and black and white illustrations; No Copyright; Avail: CASI; , Electronic Document; Order hardcopy or CD-ROM from the U.S. Government Printing Office

The Columbia Accident Investigation Board's independent investigation into the tragic February 1, 2003, loss of the Space Shuttle Columbia and its seven-member crew lasted nearly seven months and involved 13 Board members, approximately 120 Board investigators, and thousands of NASA and support personnel. Because the events that initiated the accident were not apparent for some time, the investigation's depth and breadth were unprecedented in NASA history. Further, the Board determined early in the investigation that it intended to put this accident into context. We considered it unlikely that the accident was a random event; rather, it was likely related in some degree to NASA's budgets, history, and program culture, as well as to the politics, compromises, and changing priorities of the democratic process. We are convinced that the management practices overseeing the Space Shuttle Program were as much a cause of the accident as the foam that struck the left wing. The Board was also influenced by discussions with members of Congress, who suggested that this nation needed a broad examination of NASA's Human Space Flight Program, rather than just an investigation into what physical fault caused Columbia to break up during re-entry. Findings and recommendations are in the relevant chapters and all recommendations are compiled in Chapter 11. Volume I is organized into four parts: The Accident; Why the Accident Occurred; A Look Ahead; and various appendices. To put this accident in context, Parts One and Two begin with histories, after which the accident is described and then analyzed, leading to findings and recommendations. Part Three contains the Board's views on what is needed to improve the safety of our voyage into space. Part Four is reference material. In addition to this first volume, there will be subsequent volumes that contain technical reports generated by the Columbia Accident Investigation Board and NASA, as well as volumes containing reference documentation and other related material.
Derived from text
Accident Investigation; Columbia (Orbiter); NASA Space Programs; Space Shuttles; Space Transportation System Flights; Reports

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*.

20030065626 NASA Langley Research Center, Hampton, VA, USA
A Thermal Analysis Approach for the Mars Odyssey Spacecraft's Solar Array
Dec, John A.; Amundsen, Ruth M.; [2003]; 11 pp.; In English; 36th AIAA Thermophysics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3764; No Copyright; Avail: CASI; A03, Hardcopy

There are numerous challenges associated with placing a spacecraft in orbit around Mars. Often. trades must be made such as the mass of the payload and the amount of fuel that can be carried. One technique employed to more efficiently place a spacecraft in orbit while maximizing payload mass (minimizing fuel use) is aerobraking. The Mars Odyssey Spacecraft made use of aerobraking to gradually reduce its orbit period from a highly elliptical insertion orbit to its final science orbit. Aerobraking introduces its own unique challenges, in particular, predicting the thermal response of the spacecraft and its components during each aerobraking drag pass. This paper describes the methods used to perform aerobraking thermal analysis using finite element thermal models of the Mars Odyssey Spacecraft's solar array. To accurately model the complex behavior during aerobraking, the thermal analysis must be tightly coupled to the spatially varying, time dependent aerodynamic heating analysis. Also, to properly represent the temperatures prior to the start of the drag pass. the model must include the orbital solar and planetary heat fluxes. It is critical that the thermal behavior be predicted accurately to maintain the solar array below its structural flight allowable temperature limit. The goal of this paper is to describe a thermal modeling method that was developed for this purpose.
Author
2001 Mars Odyssey; Solar Arrays; Thermal Analysis; Three Dimensional Models; Aerobraking

20030065874 ATK-Thiokol Propulsion, Brigham City, UT, USA
Investigation Leads to Improved Understanding of Space Shuttle RSRM Internal Insulation Joints
McWhorter, Bruce B.; Bolton, Doug E.; Hicken, Steve V.; Allred, Larry D.; Cook, Dave J.; [2003]; 13 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conferece, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2003-5108; No Copyright; Avail: CASI; A03, Hardcopy

The Space Shuttle Reusable Solid Rocket Motor (RSRM) uses an internal insulation J-joint design for the mated insulation interface between two assembled RSRM segments. In this assembled (mated) segment configuration, this J-joint design serves as a thermal barrier to prevent hot gases from affecting the case field joint metal surfaces and O-rings. A pressure sensitive adhesive (PSA) provides some adhesion between the two mated insulation surfaces. In 1995, after extensive testing, a new ODC-free PSA (free of ozone depleting chemicals) was selected for flight on RSRM-55 (STS-78). Post-flight inspection revealed that the J-joint, equipped with the new ODC-free PSA, did not perform well. Hot gas seeped inside the J-joint interface. Although not a flight safety threat, the J-joint hot gas intrusion on RSRM-55 was a mystery to the investigators since the PSA had previously worked well on a full-scale static test. A team was assembled to study the J-joint and PSA further. All J-joint design parameters, measured data, and historical performance data were re-reviewed and evaluated by subscale testing and analysis. Although both the ODC-free and old PSA were weakened by humidity, the ODC-free PSA strength was lower to start with. Another RSRM full-scale static test was conducted in 1998 and intentionally duplicated the gas intrusion. This test, along with many concurring tests, showed that if a J-joint was 1) mated with the new ODC-free PSA, 2) exposed to a history of high humidity (Kennedy Space Center levels), and 3) also a joint which experienced significant but normal joint motion (J-joint deformation resulting from motor pressurization dynamics) then that J-joint would open (allow gas intrusion) during motor operation. When all of the data from the analyses, subscale tests, and full-scale tests were considered together, a theory emerged. Most of the joint motion on the RSRM occurs early in motor operation at which point the J-joints are pulled into tension. If the new PSA has been weakened due to humidity, then the J-joint will partially pull apart (inboard side), and the J-joint surfaces will be charred by exposure to hot gases. After early operation, a J-joint that has been pulled apart will come back together as the J-joint deformation decreases. This J-joint heating event is relatively short and occurs only during the first part of motor operation. Internal instrumentation was developed for another full-scale static test in February 2000. The static test instrumentation did indeed prove this theory to be correct. Post-test inspection revealed very similar charring

characteristics as observed on RSRM-55. This experience of the development of a new PSA, its testing, the RSRM-55 flight, followed by the J-joint investigation led to good 'lessons learned' and to an additional fundamental understanding of the RSRM J-joint function.
Author
Space Shuttle Boosters; Joints (Junctions); Thermal Insulation; Adhesives; Design Analysis

20030065922 NASA Marshall Space Flight Center, Huntsville, AL, USA
CFD Process Pre- and Post-processing Automation in Support of Space Propulsion
Dorney, Suzanne M.; [2003]; 7 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-5051; Copyright; Avail: CASI; A02, Hardcopy

The use of Computational Fluid Dynamics or CFD has become standard practice in the design and analysis of the major components used for space propulsion. In an attempt to standardize and improve the CFD process a series of automated tools have been developed. Through the use of these automated tools the application of CFD to the design cycle has been improved and streamlined. This paper presents a series of applications in which deficiencies were identified in the CFD process and corrected through the development of automated tools.
Author
Computational Fluid Dynamics; Engine Design; Automation; Computer Programs

20030065923 NASA Marshall Space Flight Center, Huntsville, AL, USA, NASA Johnson Space Center, Houston, TX, USA
NASA's New Orbital Space Plane: A Bridge to the Future
Davis, Stephan R.; Engler, Leah M.; Fisher, Mark F.; Dumbacher, Dan L.; Boswell, Barry E.; [2003]; 15 pp.; In English; AIAA 10th Anniverary of Flight, 14-17 Jul. 2003, Dayton, OH, USA; No Copyright; Avail: CASI; A03, Hardcopy

NASA is developing a new spacecraft system called the Orbital Space Plane (OSP). The OSP will be launched on an expendable launch vehicle and serve to augment the shuttle in support of the International Space Station by transporting astronauts to and from the International Space Station and by providing a crew rescue system.
Author
Aerospace Planes; Development; Project Management

20030065957 NASA Marshall Space Flight Center, Huntsville, AL, USA
Design and Testing of Non-Toxic RCS Thrusters for Second Generation Reusable Launch Vehicle
Calvignac, Jacky; Tramel, Terri; [2003]; 2 pp.; In English; Joint Propulsion Conference, Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-01110; No Copyright; Avail: Other Sources; Abstract Only

The current NASA Space Shuttle auxiliary propulsion system utilizes nitrogen tetroxide (NTO) and monomethylhydrazine (MMH), hypergolic propellants. This use of these propellants has resulted in high levels of maintenance and precautions that contribute to costly launch operations. By employing alternate propellant combinations, those less toxic to humans, the hazards and time required between missions can be significantly reduced. Use of alternate propellants can thereby increase the efficiency and lower the cost in launch operations. In support of NASA's Space Launch Initiative (SLI), TRW proposed a three-phase project structured to significantly increase the technology readiness of a high-performance reaction control subsystem (RCS) thruster using non-toxic propellant for an operationally efficient and reusable auxiliary propulsion system (APS). The project enables the development of an integrated primary/vernier thruster capable of providing dual-thrust levels of both 1000-lbf class thrust and 25-lbf thrust. The intent of the project is to reduce the risk associated with the development of an improved RCS flight design that meets the primary NASA objectives of improved safety and reliability while reducing systems operations and maintenance costs. TRW proposed two non-toxic auxiliary propulsion engine designs, one using liquid oxygen and liquid hydrogen and the other using liquid oxygen and liquid ethanol, as candidates to meet the goals of reliability and affordability at the RCS level. Both of these propellant combinations offer the advantage of a safe environment for maintenance, while at the same time providing adequate to excellent performance for a conventional liquid propulsion systems. The key enabling technology incorporated in both TRW thrusters is the coaxial liquid on liquid pintle injector. This paper will concentrate on only the design and testing of one of the thrusters, the liquid oxygen (LOX) and liquid hydrogen (LH2) thruster. The LOX/LH2 thruster design includes a LOX-centered pintle injector, consisting of two rows of slots that create a radial spoke spray pattern in the combustion chamber. The main fuel injector creates a continuous sheet of LH2 originating upstream of the LOX pintle injector. The two propellants impinge at the pintle slots, where the resulting momentum ratio and spray pattern determines the combustion efficiency and thermal effects on the hardware. Another enabling

technology used in the design of this thruster is fuel film cooling through a duct, lining the inner wall of the combustion chamber barrel section. The duct is also acts as a secondary fuel injection point. The variation in the amount of LH2 used for the duct allows for adjustments in the cooling capacity for the thruster. The Non-Toxic LOX-LH2 RCS Workhorse Thruster was tested at the NASA Marshall Space Flight Center's Test Stand 500. Hot-fire tests were conducted between March 08, 2002 and April 05, 2002. All testing during the program base period were performed at sea-level conditions. During the test program, 7 configurations were tested, including 2 combustion chambers, 3 LOX injector pintle tips, and 4 LH2 injector stroke settings. The operating conditions that were surveyed varied thrust levels, mixture ratio and LH2 duct cooling flow. The copper heat sink chamber was used for 16 burns, each burn lasting from 0.4 to 10 seconds, totaling 51.4 seconds, followed by Haynes chamber testing ranging from 0.9 to 120 seconds, totaling 300.9 seconds. The total accumulated burn time for the test program is 352.3 seconds. C* efficiency was calculated and found to be within expectable limits for most operating conditions. The temperature on the Haynes combustion chamber remained below established material limits, with the exception of one localized hot spot. The test results demonstrate that both the coaxial liquid-on-liquid pintle injector design and fuel duct concepts are viable for the intended application. The thruster head-e design maintained cryogenic injection temperatures while firing, which validates the concept for minimal heat soak back. By injecting fuel into the duct, the throat temperatures were manageable, yet the split of fuel through the cooling duct does not compromise the overall combustion efficiency, which indicates that, provided proper design refinement, such a concept can be applied to a high-performance version of the thruster. These hot fire tests demonstrate the robustness of the duct design concept and good capability to withstand off-nominal operating conditions without adversely impacting the thermal response of the engine, a key design feature for a cryogenic thruster.
Author
Liquid Rocket Propellants; Thrustors; Ethyl Alcohol; Engine Tests; Aerospace Safety; Hydrogen Fuels; Liquid Hydrogen; Liquid Oxygen

20030065959 NASA Marshall Space Flight Center, Huntsville, AL, USA
Technology Development Activities for the Space Environment and its Effects on Spacecraft
Kauffman, Billy; Hardage, Donna; Minor, Jody; Barth, Janet; LaBel, Ken; March 31, 2003; 9 pp.; In English; AIAA/ICAS Internation Air and Space Symposium Exposition, 14-18 Jul. 2003, Dayton, OH, USA; No Copyright; Avail: CASI; A02, Hardcopy

Reducing size and weight of spacecraft, along with demanding increased performance capabilities, introduces many uncertainties in the engineering design community on how emerging microelectronics will perform in space. The engineering design community is forever behind on obtaining and developing new tools and guidelines to mitigate the harmful effects of the space environment. Adding to this complexity is the push to use Commercial-off-the-shelf (COTS) and shrinking microelectronics behind less shielding and the potential usage of unproven technologies such as large solar sail structures and nuclear electric propulsion. In order to drive down these uncertainties, various programs are working together to avoid duplication, save what resources are available in this technical area and possess a focused agenda to insert these new developments into future mission designs. This paper will describe the relationship between the Living With a Star (LWS): Space Environment Testbeds (SET) Project and NASA's Space Environments and Effects (SEE) Program and their technology development activities funded as a result from the recent SEE Program's NASA Research Announcement.
Author
Aerospace Environments; NASA Programs; Research And Development

20030066090 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Icy Satellites Impactor Probes for the Jovian Icy Moons Orbiter
Shirley, J. H.; Zimmerman, W. F.; Strauss, W.; Ivlev, R.; Duong, T.; Hunter, D.; Slimko, E.; Nacaise, F.; Archer, E.; Nesmith, B., et al.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 73; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

We present a preliminary design and mission description for Icy Satellites Impactor Probes (IPS). This design addresses two of the scientific themes of this Icy Galilean Satellites Forum: Surface Chemistry and Geophysics, and Interior Structures. Impactor probes may also make significant contributions in the areas of surface geology and mineralogy.
Derived from text
Galilean Satellites; Satellite Surfaces; Space Probes; Spacecraft Design; Spacecraft Instruments; Instrument Packages

20030066096 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

JIMO Delivery and Support of a Jupiter Deep Entry Probe

Spilker, T. R.; Young, R. E., et al.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 83; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The 2003 Solar System Exploration Decadal Survey ('SSEDS') emphasizes the significant science available from Jupiter deep entry probes. Studies performed at JPL this year identified a mission design that would allow JIMO to deliver and support one or more entry probes that reach the 100-bar level in Jupiter's atmosphere, with relatively minor modifications to JIMO s preliminary mission design. Notably, the icy moon tour mission design, beginning with Callisto approach, is unaffected. This proposed mission design would offer the option of adding a rich new set of high-priority SSEDS science objectives to the planned JIMO mission for a relatively small investment.

Derived from text

Jupiter Probes; Mission Planning; Trajectory Planning; Payloads; Systems Engineering; Structural Design; Satellite Design

20030066211 NASA Marshall Space Flight Center, Huntsville, AL, USA

International Space Station Internal Thermal Control System Lab Module Simulator Build-Up and Validation

Wieland, Paul; Miller, Lee; Ibarra, Tom; [2003]; 8 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada

Contract(s)/Grant(s): 336-33-30-00-FG

Report No.(s): SAE-2003-01-2519; Copyright; Avail: CASI; A02, Hardcopy

As part of the Sustaining Engineering program for the International Space Station (ISS), a ground simulator of the Internal Thermal Control System (ITCS) in the Lab Module was designed and built at the Marshall Space Flight Center (MSFC). To support prediction and troubleshooting, this facility is operationally and functionally similar to the flight system and flight-like components were used when available. Flight software algorithms, implemented using the LabVIEW(Registered Trademark) programming language, were used for monitoring performance and controlling operation. Validation testing of the low temperature loop was completed prior to activation of the Lab module in 2001. Assembly of the moderate temperature loop was completed in 2002 and validated in 2003. The facility has been used to address flight issues with the ITCS, successfully demonstrating the ability to add silver biocide and to adjust the pH of the coolant. Upon validation of the entire facility, it will be capable not only of checking procedures, but also of evaluating payload timelining, operational modifications, physical modifications, and other aspects affecting the thermal control system.

Author

Temperature Control; International Space Station; Applications Programs (Computers); Low Temperature; Programming Languages; Flight Control

20030066225 NASA Glenn Research Center, Cleveland, OH, USA

Microgravity Emissions Laboratory Testing of the Light Microscopy Module Control Box Fan

McNelis, Anne M.; Samorezov, Sergey; Haecker, Anthony H.; July 2003; 13 pp.; In English; Noise-Con 2003, 23-25 Jun. 2003, Cleveland, OH, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 400-32-30-03

Report No.(s): NASA/TM-2003-212333; E-13927; NAS 1.15:212333; Copyright; Avail: CASI; A03, Hardcopy

The Microgravity Emissions Laboratory (MEL) was developed at the NASA Glenn Research Center for the characterization, simulation, and verification of the International Space Station (ISS) microgravity environment. This Glenn lab was developed in support of the Fluids and Combustion Facility (FCF). The MEL is a six-degrees-of-freedom inertial measurement system that can characterize the inertial response forces (emissions) of components, subrack payloads, or rack-level payloads down to lO(exp -7)g. The inertial force output generated from the steady-state or transient operations of the test article are used with finite element analysis, statistical energy analysis, and other analysis tools to predict the on-orbit environment at specific science or rack interface locations. Customers of the MEL have used the benefits of isolation performance testing in defining available attenuation during the engineering hardware design phase of their experiments. The Light Microscopy Module (LMM) Control Box (LCB) fan was tested in the MEL in June and July of 2002. The LMM is planned as a remotely controllable on-orbit microscope subrack facility that will be accommodated in an FCF Fluids Integrated Rack on the ISS. This report describes the MEL, the testing process, and the results from ground-based MEL LCB fan testing.

Author

Microgravity; Statistical Analysis; Finite Element Method; Combustion Chambers; Performance Tests; Degrees Of Freedom

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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*.

20030066006 Boeing Co., Huntsville, AL, USA
ISS Payload Racks Automated Flow Control Calibration Method
Simmonds, Boris G.; [2003]; 4 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada
Contract(s)/Grant(s): NAS8-50000
Report No.(s): SAE-03ICES-235; Copyright; Avail: CASI; A01, Hardcopy

Payload Racks utilize MTL and/or LTL station water for cooling of payloads and avionics. Flow control range from valves of fully closed, to up to 300 Ibmhr. Instrument accuracies are as high as f 7.5 Ibm/hr for flow sensors and f 3 Ibm/hr for valve controller, for a total system accuracy of f 10.5 Ibm/hr. Improved methodology was developed, tested and proven that reduces accuracy of the commanded flows to less than f 1 Ibmhr. Uethodology could be packed in a 'calibration kit' for on- orbit flow sensor checkout and recalibration, extending the rack operations before return to earth. -
Author
International Space Station; Payload Stations; Automatic Control; Calibrating; Flow Measurement

20030066009 NASA Marshall Space Flight Center, Huntsville, AL, USA
Hardware Evolution of Analog Speed Controllers for a DC Motor
Gwaltney, David A.; Ferguson, Michael I.; [2003]; 11 pp.; In English; Genetic and Evolutionary Computation Conference (GECCO) 2003, 12-16 Jul. 2003, Chicago, IL, USA; Copyright; Avail: CASI; A03, Hardcopy

Evolvable hardware provides the capability to evolve analog circuits to produce amplifier and filter functions. Conventional analog controller designs employ these same functions. Analog controllers for the control of the shaft speed of a DC motor are evolved on an evolvable hardware platform utilizing a Field Programmable Transistor Array (FPTA). The performance of these evolved controllers is compared to that of a conventional proportional-integral (PI) controller.
Author
Actuators; Electric Motors; Controllers; Speed Control

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SPACECRAFT PROPULSION AND POWER

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

20030065656 NASA Marshall Space Flight Center, Huntsville, AL, USA
Analysis of Parallel Burn Without Crossfeed TSTO RLV Architectures and Comparison to Parallel Burn With Crossfeed and Series Burn Architectures
Smith, Garrett; Phillips, Alan; November 4, 2002; 1 pp.; In English; 39th Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-02057; Copyright; Avail: Other Sources; Abstract Only

There are currently three dominant TSTO class architectures. These are Series Burn (SB), Parallel Burn with crossfeed (PBw/cf), and Parallel Burn without crossfeed (PBncf). The goal of this study was to determine what factors uniquely affect PBncf architectures, how each of these factors interact, and to determine from a performance perspective whether a PBncf vehicle could be competitive with a PBw/cf or SB vehicle using equivalent technology and assumptions. In all cases, performance was evaluated on a relative basis for a fixed payload and mission by comparing gross and dry vehicle masses of a closed vehicle. Propellant combinations studied were LOX: LH2 propelled orbiter and booster (HH) and LOX: Kerosene booster with LOX: LH2 orbiter (KH). The study conclusions were: 1) a PBncf orbiter should be throttled as deeply as possible after launch until the staging point. 2) a detailed structural model is essential to accurate architecture analysis and evaluation. 3) a PBncf TSTO architecture is feasible for systems that stage at mach 7. 3a) HH architectures can achieve a mass growth relative to PBw/cf of < 20%. 3b) KH architectures can achieve a mass growth relative to Series Burn of < 20%. 4) center of

gravity (CG) control will be a major issue for a PBncf vehicle, due to the low orbiter specific thrust to weight ratio and to the position of the orbiter required to align the nozzle heights at liftoff. 5) thrust to weight ratios of 1.3 at liftoff and between 1.0 and 0.9 when staging at mach 7 appear to be close to ideal for PBncf vehicles. 6) performance for all vehicles studied is better when staged at mach 7 instead of mach 5. The study showed that a Series Burn architecture has the lowest gross mass for HH cases, and has the lowest dry mass for KH cases. The potential disadvantages of SB are the required use of an air-start for the orbiter engines and potential CG control issues. A Parallel Burn with crossfeed architecture solves both these problems, but the mechanics of a large bipropellant crossfeed system pose significant technical difficulties. Parallel Burn without crossfeed vehicles start both booster and orbiter engines on the ground and thus avoid both the risk of orbiter air-start and the complexity of a crossfeed system. The drawback is that the orbiter must use 20% to 35% of its propellant before reaching the staging point. This induces a weight penalty in the orbiter in order to carry additional propellant, which causes a further weight penalty in the booster to achieve the same staging point. One way to reduce the orbiter propellant consumption during the first stage is to throttle down the orbiter engines as much as possible. Another possibility is to use smaller or fewer engines. Throttling the orbiter engines soon after liftoff minimizes CG control problems due to a low orbiter liftoff thrust, but may result in an unnecessarily high orbiter thrust after staging. Reducing the number or size of engines size may cause CG control problems and drift at launch. The study suggested possible methods to maximize performance of PBncf vehicle architectures in order to meet mission design requirements.
Author
Combustion; Propulsion System Configurations; Propulsion System Performance; Reusable Launch Vehicles

20030065836 NASA Marshall Space Flight Center, Huntsville, AL, USA
Numerical Modeling of Fluid Transient in Cryogenic Fluid Network of Rocket Propulsion System
Majumdar, Alok; Flachbart, Robin; [2003]; 3 pp.; In English; 2003 ASME/JSME Joint Fluids Engineering Conference 2nd International Symposium on Water Hammer, 6-10 Jul. 2003, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

Fluid transients, also known as water hammer, can have a significant impact on the design and operation of both spacecraft and launch vehicles propulsion systems. These transients often occur at system activation and shut down. For ground safety reasons, many spacecrafts are launched with the propellant lines dry. These lines are often evacuated by the time the spacecraft reaches orbit. When the propellant isolation valve opens during propulsion system activation, propellant rushes into lines creating a pressure surge. During propellant system shutdown, a pressure surge is created due to sudden closure of a valve. During both activation and shutdown, pressure surges must be predicted accurately to ensure structural integrity of the propulsion system fluid network. The method of characteristics is the most widely used method of calculating fluid transients in pipeline [1,2]. The method of characteristics, however, has limited applications in calculating flow distribution in complex flow circuits with phase change, heat transfer and rotational effects. A robust cryogenic propulsion system analyzer must have the capability to handle phase change, heat transfer, chemical reaction, rotational effects and fluid transients in conjunction with subsystem flow model for pumps, valves and various pipe fittings. In recent years, such a task has been undertaken at Marshall Space Flight Center with the development of the Generalized Fluid System Simulation Program (GFSSP), which is based on finite volume method in fluid network [3]. GFSSP has been extensively verified and validated by comparing its predictions with test data and other numerical methods for various applications such as internal flow of turbo-pump [4], propellant tank pressurization [5,6], chilldown of cryogenic transfer line [7] and squeeze film damper rotordynamics [8]. The purpose of the present paper is to investigate the applicability of the finite volume method to predict fluid transient in cryogenic flow circuits.
Author
Cryogenic Rocket Propellants; Fluid Flow; Water Hammer

20030065841 NASA Marshall Space Flight Center, Huntsville, AL, USA
Rocket Engine Health Management: Early Definition of Critical Flight Measurements
Christenson, Rick L.; Nelson, Michael A.; Butas, John P.; July 2003; 10 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-5251; No Copyright; Avail: CASI; A02, Hardcopy

The NASA led Space Launch Initiative (SLI) program has established key requirements related to safety, reliability, launch availability and operations cost to be met by the next generation of reusable launch vehicles. Key to meeting these requirements will be an integrated vehicle health management (M) system that includes sensors, harnesses, software, memory, and processors. Such a system must be integrated across all the vehicle subsystems and meet component, subsystem, and system requirements relative to fault detection, fault isolation, and false alarm rate. The purpose of this activity is to evolve

techniques for defining critical flight engine system measurements-early within the definition of an engine health management system (EHMS). Two approaches, performance-based and failure mode-based, are integrated to provide a proposed set of measurements to be collected. This integrated approach is applied to MSFC s MC-1 engine. Early identification of measurements supports early identification of candidate sensor systems whose design and impacts to the engine components must be considered in engine design.
Author
Reusable Launch Vehicles; Rocket Engines; Failure Modes; Fault Detection; False Alarms; Reliability

20030065851 Nauchno-Proizvodstvennoe Obedinenie Prikladnoi Mekhaniki, Krasnoyarsk, Russia
Hall Effect Thruster Interactions Data From the Russian Express-A2 and Express-A3 Satellites. Acquire Express-A2 SPT-100 Based Propulsion Subsystem and Other Subsystem Flight Operation TM-Data for the Period of March 12, 2000 to and Including June 15, 2000, Task 29
Sitnikova, N.; Volkov, D.; Maximov, I.; Petrusevich, V.; Allen, D.; June 2003; 154 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-99151; NAS3-99204; WBS-22-800-91-01
Report No.(s): NASA/CR-2003-212005/PT1; NAS 1.26:212005/PT1; E-13691-1/PT1; No Copyright; Avail: CASI; A08, Hardcopy

This 12-part report documents the data obtained from various sensor measurements taken aboard the Russian Express-A2 and Express-A3 spacecraft in Geosynchronous Earth Orbit (GEO). These GEO communications satellites, which were designed and built by NPO Prikladnoy Mekhaniki (NPO PM) of Zheleznogorsk, Russia, utilize Hall thruster propulsion systems for north-south and east-west stationkeeping and as of June 2002, were still operating at 80 E. and 11 W., respectively. Express-A2 was launched on March 12, 2000, while Express-A3 was launched on June 24, 2000. The diagnostic equipment from which these data were taken includes electric field strength sensors, ion current and energy sensors, and pressure sensors. The diagnostics and the Hall thruster propulsion systems are described in detail along with lists of tabular data from those diagnostics and propulsion system and other satellite systems. Space Power, Inc., now part of Pratt & Whitney s Chemical Systems Division, under contract NAS3 99151 to the NASA Glenn Research Center, obtained these data over several periods from March 12, 2000, through September 30, 2001. Each of the 12 individual reports describe, in detail, the propulsion systems as well as the diagnostic sensors utilized. Finally, parts 11 and 12 include the requirements to which NPO PM prepared and delivered these data.
Author
Hall Effect; Hall Thrusters; Electric Propulsion; Spacecraft Configurations; Spacecraft Orbits; Spacecraft Control

20030065886 NASA Marshall Space Flight Center, Huntsville, AL, USA
Study of a High-Energy Upper Stage for Future Shuttle Missions
Dressler, Gordon A.; Matuszak, Leo W.; Stephenson, David D.; July 20, 2003; 11 pp.; In English; 39th AIAA Joint propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-01110
Report No.(s): AIAA Paper 2003-5128; No Copyright; Avail: CASI; A03, Hardcopy

Space Shuttle Orbiters are likely to remain in service to 2020 or beyond for servicing the International Space Station and for launching very high value spacecraft. There is a need for a new STS-deployable upper stage that can boost certain Orbiter payloads to higher energy orbits, up to and including Earth-escape trajectories. The inventory of solid rocket motor Inertial Upper Stages has been depleted, and it is unlikely that a LOX/LH2-fueled upper stage can fly on Shuttle due to safety concerns. This paper summarizes the results of a study that investigated a low cost, low risk approach to quickly developing a new large upper stage optimized to fly on the existing Shuttle fleet. Two design reference missions (DRMs) were specified: the James Webb Space Telescope (JWST) and the Space Interferometry Mission (SIM). Two categories of upper stage propellants were examined in detail: a storable liquid propellant and a storable gel propellant. Stage subsystems ‘other than propulsion were based largely on heritage hardware to minimize cost, risk and development schedule span. The paper presents the ground rules and guidelines for conducting the study, the preliminary conceptual designs margins, assessments of technology readiness/risk, potential synergy with other programs, and preliminary estimates of development and production costs and schedule spans. Although the Orbiter Columbia was baselined for the study, discussion is provided to show how the results apply to the remaining STS Orbiter fleet.
Author
Space Shuttle Missions; International Space Station; Space Shuttle Orbiters; Space Transportation System; Spacecraft Propulsion; Liquid Rocket Propellants; Upper Stage Rocket Engines

20030065887 ATK-Thiokol Propulsion, Brigham City, UT, USA

RSRM and ETM03 Internal Flow Simulations and Comparisons

Ahmad, R. A.; Morstadt, R. A.; Eaton, A. M.; [2003]; 12 pp.; In English; 39th Joint Propulsion Conference, Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-97238

Report No.(s): AIAA Paper 2003-5104; Copyright; Avail: CASI; A03, Hardcopy

ETM03 (Engineering Test Motor-03) is an extended length RSRM (Reusable Solid Rocket Motor) designed to increase motor performance and create more severe internal environments compared with the standard four-segment RSRM motor configuration. This is achieved primarily through three unique design features. First is the incorporation of an additional RSRM center segment, second is a slight increase in throat diameter, and third is the use of an Extended Aft Exit Cone (EAEC). As a result of these design features, parameters such as web time, action time, head end pressure, web time average pressure, maximum thrust, mass flow rate, centerline Mach number, pressure and thrust integrals have all increased compared with nominal RSRM values. In some cases these increases are substantial. The primary objective of the ETM03 test program is to provide a platform for RSRM component margin testing. Test results will not only provide direct data concerning component performance under more adverse conditions, but serve as a second design data point for developing, validating and enhancing component analytical modeling techniques. To help component designers assess how the changes in motor environment will affect performance, internal flow simulations for both the nominal RSRM and ETM03 motor designs were completed to obtain comparisons of aero-thermal boundary conditions and system loads. Full geometries for both motors were characterized with two-dimensional axi-symmetric models at burn times of 1, 20, 54, 67 and 80-seconds. A sixth set considered burn times of 110 and 117-seconds for RSRM and ETM03, respectively. The simulations were performed using the computational fluid dynamics (CFD) commercial code FLUENT (trademark). Of particular interest were any differences between the two motor environments that could lead to a significant increase in system loads, or in internal insulation and/or nozzle component charring and erosion in ETM03 compared with RSRM. Based on these comparative analyses conducted in this study, the objective of ETM03 will be achieved by providing a more adverse operating environment for motor components than the nominal RSRM environment. For example: Higher chamber pressure drop in ETM03 than in RSRM; higher centerline Mach numbers approaching the nozzle in ETM03 than in RSRM; higher heat transfer rates for the internal insulation and nozzle components in ETM03 than in RSRM; and higher levels of droplet impingement and slag accumulation in ETM03 than in the RSRM.

Author

Solid Propellant Rocket Engines; Reusable Rocket Engines; Internal Flow; Two Dimensional Models; Computerized Simulation

20030065894 Science Applications International Corp., Huntsville, AL, USA

A Titan Explorer Mission Utilizing Solar Electric Propulsion and Chemical Propulsion Systems

Cupples, Michael; Coverstone, Vicki; [2003]; 14 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Report No.(s): AIAA Paper 2003-4728; No Copyright; Avail: CASI; A03, Hardcopy

Mission and Systems analyses were performed for a Titan Explorer Mission scenario utilizing medium class launch vehicles, solar electric propulsion system (SEPS) for primary interplanetary propulsion, and chemical propulsion for capture at Titan. An examination of a range of system factors was performed to determine their affect on the payload delivery capability to Titan. The effect of varying the launch vehicle, solar array power, associated number of SEPS thrusters, chemical propellant combinations, tank liner thickness, and tank composite overwrap stress factor was investigated. This paper provides a parametric survey of the aforementioned set of system factors, delineating their affect on Titan payload delivery, as well as discussing aspects of planetary capture methodology.

Author

Solar Electric Propulsion; Chemical Propulsion; Interplanetary Flight; Propellant Tanks

20030065897 NASA Glenn Research Center, Cleveland, OH, USA

Solar Electric Propulsion Mission Architectures

Kerslake, Thomas W.; June 2003; 20 pp.; In English; Space Power Workshop 2003, 21-24 Apr. 2003, Redondo Beach, CA, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS-22-755-12-16

Report No.(s): NASA/TM-2003-212456; NAS 1.15:212456; E-13995; No Copyright; Avail: CASI; A03, Hardcopy

This presentation reviews Solar Electric Propulsion (SEP) Mission Architectures with a slant towards power system

technologies and challenges. The low-mass, high-performance attributes of SEP systems have attracted spacecraft designers and mission planners alike and have led to a myriad of proposed Earth orbiting and planetary exploration missions. These SEP missions are discussed from the earliest missions in the 1960's, to first demonstrate electric thrusters, to the multi-megawatt missions envisioned many decades hence. The technical challenges and benefits of applying high-voltage arrays, thin film and low-intensity, low-temperature (LILT) photovoltaics, gossamer structure solar arrays, thruster articulating systems and microsat systems to SEP spacecraft power system designs are addressed. The overarching conclusion from this review is that SEP systems enhance, and many times enable, a wide class of space missions.
Author
Space Missions; Solar Electric Propulsion; Propulsion System Configurations; Interplanetary Spacecraft

20030065898 Boeing Phantom Works, Huntsville, AL, USA
High Power Electric Propulsion for Outer Planet Missions
Donahue, Benjamin B.; [2003]; 8 pp.; In English; AIAA Joint Propulsion Conference, 23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): GS-234-01075; Copyright; Avail: CASI; A02, Hardcopy

Focused technology trade studies for Nuclear Electric Propulsion vehicle concepts for outer planet missions are presented; representative mission, vehicle and technology characterizations illustrate samples of work done under the NASA Marshall Space Flight Center-Boeing-SAIC In-Space Technology Assessment (ISTA) contract. An objective of ISTA is to identify and present sound technical and programtic options for the formulation and implementation of advanced electric and chemical propulsion solar system exploration missions. Investigations to date include a variety of outer planet destinations, trip times, science payload allotments, orbital capture techniques, all conducted to illustrate how advanced technology would maximize mission benefits. Architecture wide optimizations that facilitate good propulsion technology investments for advanced electric and chemical propulsion systems were conducted, including those relevant to the nuclear system initiative. Representative analyses of vehicles utilizing fission reactors with advanced power generation, Conversion, processing and electric propulsion systems, which would enable scientifically rich robotic exploration missions, are presented.
Author
Interplanetary Spacecraft; Space Exploration; Nuclear Electric Propulsion; Propulsion System Configurations; Technology Assessment

20030065924 NASA Marshall Space Flight Center, Huntsville, AL, USA
Evaluation of Impinging Stream Vortex Chamber Concepts for Liquid Rocket Engine Applications
Trinh, Huu P.; Bullard, Brad; Kopicz, Charles; Michaels, Scott; December 03, 2002; 2 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A01, Hardcopy

To pursue technology developments for future launch vehicles, NASA/Marshall Space Flight Center (MSFC) is examining vortex chamber concepts for liquid rocket engine applications. Past studies indicated that the vortex chamber schemes potentially have a number of advantages over conventional chamber methods. Due to the nature of the vortex flow, relatively cooler propellant streams tend to flow along the chamber wall. Hence, the thruster chamber can be operated without the need of any cooling techniques. This vortex flow also creates strong turbulence, which promotes the propellant mixing process. Consequently, the subject chamber concepts not only offer system simplicity, but also enhance the combustion performance. Test results have shown that chamber performance is markedly high even at a low chamber length-to-diameter ratio (LD). This incentive can be translated to a convenience in the thrust chamber packaging. Variations of the vortex chamber concepts have been introduced in the past few decades. These investigations include an ongoing work at Orbital Technologies Corporation (ORBITEC). By injecting the oxidizer tangentially at the chamber convergence and fuel axially at the chamber head end, Knuth et al. were able to keep the wall relatively cold. A recent investigation of the low L/D vortex chamber concept for gel propellants was conducted by Michaels. He used both triplet (two oxidizer orifices and one fuel orifice) and unlike impinging schemes to inject propellants tangentially along the chamber wall. Michaels called the subject injection scheme an Impinging Stream Vortex Chamber (ISVC). His preliminary tests showed that high performance, with an Isp efficiency of 9295, can be obtained. MSFC and the U. S. Army are jointly investigating an application of the ISVC concept for the cryogenic oxygen/hydrocarbon propellant system. This vortex chamber concept is currently tested with gel propellants at AMCOM at Redstone Arsenal, Alabama. A version of this concept for the liquid oxygen (LOX) hydrocarbon fuel (RP-1) system has been derived from the one for the gel propellant. An unlike impinging injector was employed to deliver the propellants to the chamber. MSFC is also conducting an alternative injection scheme, called the chasing injector, associated with this vortex chamber concept. In this injection technique, both propellant jets and their impingement point are in the same chamber cross-sectional plane. Long duration tests (approximately up to 15 seconds) will be conducted on the ISVC to study the thermal effects. This paper will report the progress of the subject efforts at NASA Marshall Space Flight Center. Thrust

chamber performance and thermal wall compatibility will be evaluated. The chamber pressures, wall temperatures, and thrust will be measured as appropriate. The test data will be used to validate CFD models, which, in turn, will be used to design the optimum vortex chambers. Measurements in the previous tests showed that the chamber pressures vary significantly with radius. This is due to the existence of the vortices in the chamber flow field. Hence, the combustion efficiency may not be easily determined from chamber pressure. For this project, measured thrust data will be collected. The performance comparison will be in terms of specific impulse efficiencies. In addition to the thrust measurements, several pressure and temperature readings at various locations on the chamber head faceplate and the chamber wall will be made. The first injector and chamber were designed and fabricated based on the available data and experience gained during gel propellant system tests by the U.S. Army. The alternate injector for the ISVC was also fabricated. Hot-fire tests of the vortex chamber are about to start and are expected to complete in February of 2003 at the TS115 facility of MSFC.
Author
Impingement; Vortices; Liquid Propellant Rocket Engines; Thrust Chambers; Performance

20030065927 NASA Marshall Space Flight Center, Huntsville, AL, USA
Places Only Sails Can Go
Montgomery, Edward E., IV; Heaton, Andrew F.; Garbe, Gregory P.; April 1, 2003; 10 pp.; In English; AIAA/ICAS International Air and Space Symposium and Exposition: The Next 100 Years, 14-17 Jul. 2003, Dayton, OH, USA; No Copyright; Avail: CASI; A02, Hardcopy

Solar sails are a near term, low thrust, propellantless propulsion technology suitable for orbital maneuvering, station keeping, and attitude control applications for small payloads. Furthermore, these functions can be highly integrated, reducing mass, cost and complexity. The solar sail concept is based on momentum exchange with solar flux reflected from a large, deployed thin membrane. Thrust performance increases as the square of the distance to the sun. In comparison to conventional chemical systems, there are missions where solar sails are vastly more and less economical. The less attractive applications involve large payloads, outer solar system transfers, and short trip times. However, for inclination changes and station keeping at locations requiring constant thrust, the solar sail is the only economical option for missions of more than a few weeks duration. We compare the location and energies required for these applications between solar sails, advanced electric propulsion, and conventional rockets. We address the effect on mass fraction to understand solar sail mission cost and capability. Finally, the benefit of potential applications to near term science missions is reported.
Author
Solar Sails; Assessments; Cost Analysis; Spacecraft Propulsion

20030065932 NASA Marshall Space Flight Center, Huntsville, AL, USA
Evaluation and Characterization Study of Dual Pulse Laser-Induced Spark (DPLIS) For Rocket Engine Ignition System Application
Trinh, Huu P.; Early, Jim; Osborne, Robin; December 03, 2002; 4 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A01, Hardcopy

This paper addresses the progress of technology development of a laser ignition system at NASA Marshall Space Flight Center (MSFC). Initial hot-fire tests in a small-scale rocket chamber at MSFC have demonstrated the DPLIS concept having two main advantages over existing laser ignition concepts. First, the DPLIS can be potentially optimized its laser pulse format to maximize the initial plasma volume, the plasma lifetime, as well as the flame kernel growth rate. Characterization studies of the laser pulse format are now underway with experiments of igniting gaseous hydrogen/air in a Hencken burner. Once ignition is achieved, the flame is open to the atmosphere. This open environment allows easy access for diagnostics of the ignition phenomenon. The quick turn-around time of conducting experiments on this burner make it more amenable for conducting a large number of experiments for statistical analysis of the sensitivity of the test parameters. The results from these experiments will help optimize the laser format for future testing in an H2/O2 subscale rocket chamber.
Author
Ignition Systems; Rocket Engines; Laser Applications; Sparks; Pulsed Lasers

20030065938 ATK-Thiokol Propulsion, Brigham City, UT, USA
RSRM Nozzle-to-Case Joint J-leg Development
Albrechtsen, Kevin U.; Eddy, Norman F.; Ewing, Mark E.; McGuire, John R.; [2003]; 10 pp.; In English; 39th AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-9723
Report No.(s): AIAA Paper 2003-5102; Copyright; Avail: CASI; A02, Hardcopy

Since the beginning of the Space Shuttle Reusable Solid Rocket Motor (RSRM) program, nozzle-to-case joint polysulfide adhesive gas paths have occurred on several flight motors. These gas paths have allowed hot motor gases to reach the wiper O-ring. Even though these motors continue to fly safely with this condition, a desire was to reduce such occurrences. The RSRM currently uses a J-leg joint configuration on case field joints and igniter inner and outer joints. The J-leg joint configuration has been successfully demonstrated on numerous RSRM flight and static test motors, eliminating hot gas intrusion to the critical O-ring seals on these joints. Using the proven technology demonstrated on the case field joints and igniter joints, a nozzle-to-case joint J-leg design was developed for implementation on RSRM flight motors. This configuration provides an interference fit with nozzle fixed housing phenolics at assembly, with a series of pressurization gaps incorporated outboard of the joint mating surface to aid in joint pressurization and to eliminate any circumferential flow in this region. The joint insulation is bonded to the nozzle phenolics using the same pressure sensitive adhesive used in the case field joints and igniter joints. An enhancement to the nozzle-to-case joint J-leg configuration is the implementation of a carbon rope thermal barrier. The thermal barrier is located downstream of the joint bondline and is positioned within the joint in a manner where any hot gas intrusion into the joint passes through the thermal barrier, reducing gas temperatures to a level that would not affect O-rings downstream of the thermal barrier. This paper discusses the processes used in reaching a final nozzle-to-case joint J-leg design, provides structural and thermal results in support of the design, and identifies fabrication techniques and demonstrations used in arriving at the final configuration.
Author
Space Shuttle Boosters; O Ring Seals; Joints (Junctions); Polysulfides

20030065945 Nauchno-Proizvodstvennoe Obedinenie Prikladnoi Mekhaniki, Krasnoyarsk, Russia
Hall Effect Thruster Interactions Data From the Russian Express-A2 and Express-A3 Satellites
Sitnikova, N.; Volkov, D.; Maximov, I.; Petrusevich, V.; Allen, D.; June 2003; 529 pp.; In English
Contract(s)/Grant(s): NAS3-99151; NAS3-99204; WBS-22-800-91-01
Report No.(s): NASA/CR-2003-212005/Pt6; NAS 1.26:212005/Pt6; E-13691-6/Pt6; No Copyright; Avail: CASI; A23, Hardcopy

This 12-part report documents the data obtained from various sensor measurements taken aboard the Russian Express-A2 and Express-A3 spacecraft in Geosynchronous Earth Orbit (GEO). These GEO communications satellites, which were designed and built by NPO Prikladnoy Mekhaniki (NPO PM) of Zheleznogorsk, Russia, utilize Hall thruster propulsion systems for north-south and east-west stationkeeping and as of June 2002, were still operating at 80 E. and 11 W., respectively. Express-A2 was launched on March 12, 2000, while Express-A3 was launched on June 24, 2000. The diagnostic equipment from which these data were taken includes electric field strength sensors, ion current and energy sensors, and pressure sensors. The diagnostics and the Hall thruster propulsion systems are described in detail along with lists of tabular data from those diagnostics and propulsion system and other satellite systems. Space Power, Inc., now part of Pratt & Whitney's Chemical Systems Division, under contract NAS3 99151 to the NASA Glenn Research Center, obtained these data over several periods from March 12, 2000, through September 30, 2001. Each of the 12 individual reports describe, in detail, the propulsion systems as well as the diagnostic sensors utilized. Finally, parts 11 and 12 include the requirements to which NPO PM prepared and delivered these data.
Author
Hall Effect; Hall Thrusters; Electric Propulsion; Communication Satellites; Spacecraft Instruments; Data Acquisition; Russian Space Program

20030065949 NASA Marshall Space Flight Center, Huntsville, AL, USA
ISTAR: Project Status and Ground Test Engine Design
Quinn, Jason Eugene; [2003]; 13 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2003-5235; No Copyright; Avail: CASI; A03, Hardcopy

Review of the current technical and programmatic status of the Integrated System Test of an Airbreathing Rocket (ISTAR) project. November 2002 completed Phase 1 of this project: which worked the conceptual design of the X-43B demonstrator vehicle and Flight Test Engine (FTE) order to develop realistic requirements for the Ground Test Engine (GTE). The latest conceptual FTE and X-43B configuration is briefly reviewed. The project plan is to reduce risk to the GTE and FTE concepts through several tests: thruster, fuel endothermic characterization, engine structure/heat exchanger, injection characterization

rig, and full scale direct connect combustion rig. Each of these will be discussed along with the project schedule. This discussion is limited due to ITAR restrictions on open literature papers.
Author
Rocket-Based Combined-Cycle Engines; Propulsion System Configurations; Rocket Engine Design; Spacecraft Configurations; Systems Engineering; Test Vehicles; Systems Integration; Ground Tests

20030065964 NASA Marshall Space Flight Center, Huntsville, AL, USA
Propulsive Small Expendable Deployer System (ProSEDS) Experiment: Mission Overview and Status
Johnson, Les; Gilchrist, Brian; Lorenzini, Enrico; Stone, Nobie; Wright, Ken; [2003]; 9 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-5094; Copyright; Avail: Other Sources

The Propulsive Small Expendable Deployer System (ProSEDS) space experiment will demonstrate the use of an electrodynamic tether propulsion system to generate thrust in space by decreasing the orbital altitude of a Delta II expendable launch vehicle second stage. Electrodynamic tether thrusters work by virtue of the force the Earth's magnetic field exerts on a wire carrying an electrical current, achieving thrust without the expenditure of propellant. ProSEDS, which is to launch on an Air Force Global Positioning System (GPS) satellite replacement mission in early 2004, will use the flight-proven Small Expendable Deployer System (SEDS) to deploy a tether (5 km bare wire plus approximately 7 km nonconducting Dyneema (registered trademark) from a Delta II second stage to achieve a peak drag thrust of approximately 0.4 N.
Author
Electromagnetic Propulsion; Propulsion System Performance; Tetherlines; Tethering; Descent Propulsion Systems; Attitude Control; Spaceborne Experiments; Systems Engineering

20030065965 NASA Marshall Space Flight Center, Huntsville, AL, USA
Engineering of the Magnetized Target Fusion Propulsion System
Statham, G.; White, S.; Adams, R. B.; Thio, Y. C. F.; Santarius, J.; Alexander, R.; Fincher, S.; Polsgrove, T.; Chapman, J.; Philips, A.; [2002]; 23 pp.; In English; Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A03, Hardcopy

Engineering details are presented for a magnetized target fusion (MTF) propulsion system designed to support crewed missions to the outer solar system. Structural, thermal and radiation-management design details are presented. Propellant storage and supply options are also discussed and a propulsion system mass estimate is given.
Author
Fusion Propulsion; Propellant Storage

20030065979 NASA Marshall Space Flight Center, Huntsville, AL, USA
Advanced In-Space Propulsion: 'Exploring the Solar System'
Johnson, Les; [2003]; 56 pp.; In English; LibertyCon Science Fiction Convention, 25-27 Jul. 2003, Chattanooga, TN, USA; No Copyright; Avail: CASI; A04, Hardcopy

This viewgraph presentation reviews a number of advanced propulsion technologies for interplanetary spacecraft. The objective of the In Space Propulsion Technology Projects Office is to develop in-space propulsion technologies that can enable and/or benefit near and mid-term NASA science missions by significantly reducing cost, mass, and/or travel times. The technologies profiled are divided into several categories: High Priority (aerocapture, next generation ion propulsion, solar sails); Medium Priority (advanced chemical propulsion, solar electric propulsion, Hall thrusters); Low Priority (solar thermal propulsion); and High Payoff/High Risk (1 g/sq m solar sails, momentum exchange tethers, and plasma sails).
CASI
NASA Programs; Interplanetary Spacecraft; Spacecraft Propulsion

20030065984 NASA Marshall Space Flight Center, Huntsville, AL, USA
Crewed Mission to Callisto Using Advanced Plasma Propulsion Systems
Adams, R. B.; Statham, G.; White, S.; Patton, B.; Thio, Y. C. F.; Alexander, R.; Fincher, S.; Polsgrove, T.; Chapman, J.; Hopkins, R., et al.; [2003]; 34 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-4527; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes the engineering of several vehicles designed for a crewed mission to the Jovian satellite Callisto.

Each subsystem is discussed in detail. Mission and trajectory analysis for each mission concept is described. Crew support components are also described. Vehicles were developed using both fission powered magneto plasma dynamic (MPD) thrusters and magnetized target fusion (MTF) propulsion systems. Conclusions were drawn regarding the usefulness of these propulsion systems for crewed exploration of the outer solar system.
Author
Manned Spacecraft; Space Exploration; Fusion Propulsion; Callisto; Magnetoplasmadynamic Thrusters

20030066010 NASA Marshall Space Flight Center, Huntsville, AL, USA
Marshall Space Flight Center and the Reactor-in-Flight Stage: A Look Back at Using Nuclear Propulsion to Power Space Vehicles in the 1960's
Wright, Mike; [2003]; 5 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-4588; No Copyright; Avail: CASI; A01, Hardcopy

This paper examines the Marshall Space Flight Center s role in the Reactor-In-Flight (RIlT) project that NASA was involved with in the early 1960 s. The paper outlines the project s relation to the joint NASA-Atomic Energy Commission nuclear initiative known as Project Rover. It describes the justification for the RIFT project, its scope, and the difficulties that were encountered during the project. It also provides as assessment of NASA s overall capabilities related to nuclear propulsion in the early 1960 s.
Author
Nuclear Propulsion; Rover Project

20030066066 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Planetary Protection Considerations for JIMO
Koukol, R. C.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 40; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Europa is the only body in the solar system besides Mars that is currently viewed as a body of significant interest relative to the process of chemical evolution and/or the origin of life or for which scientific opinion provides a significant chance of contamination which could jeopardize a future biological experiment. Thus, both NASA and COSPAR policy require that Europa be protected from biological contamination that could result from scientific exploration conducted by robotic spacecraft. In 2000, the Task Group on the Forward Contamination of Europa (Space Studies Board) published its report on Preventing the Forward Contamination of Europa recommending a limit of 10(exp -4) probability of contamination of Europa's ocean per mission (at any time in the future) by a single viable terrestrial microbe. While NASA guidelines do not yet explicitly reflect this new recommendation, it is likely that the SSB recommendation will be adopted by NASA planetary protection in the form of a sterility requirement or at least a stringent total microbial burden requirement. In our presentation, we will present an overview of the anticipated planetary protection requirements for both orbiters and landers destined for Europa and some of the challenges these requirements will present.
Derived from text
Planetary Protection; Contamination; Europa; Mission Planning; Spacecraft Sterilization; Spacecraft Design

20030066107 QSS Group, Inc., Cleveland, OH, USA
Comparison of On-Orbit and Ground Based Hollow Cathode Operation
Patterson, Michael, Technical Monitor; Carpenter, Christian; August 2003; 16 pp.; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS3-00145; WU 575-15-69
Report No.(s): NASA/CR-2003-211817; E-13510; NAS 1.26:211817; AIAA Paper 2002-4098; No Copyright; Avail: CASI; A03, Hardcopy

The Plasma Contactor Units (PCUs) were developed at NASA Glenn Research Center (GRC) and Boeing for charge control on board the International Space Station (ISS). Since the first ignition of a PCU on 10/16/2000 over 3,900 hours of operation have been demonstrated on a single unit. In order to guarantee that the PCUs hollow cathode assemblies (HCAs), which emit the electrons used for charge control, would satisfy the life requirement of 18,000 hours, a ground based hollow cathode life test program was initiated at GRC. The life test program aimed at 27,000 hours of operation on a single unit to demonstrate the industry standard 1.5 times operational life requirement. As of this printing, over 18,000 hours of operation have been accumulated on a single hollow cathode. By comparing the data received from the on-orbit HCAs to the data

obtained for the life test cathodes, a comparison may be drawn to determine if the on-orbit HCAs are operating normally, with a final goal of predicting lifetime. Based on the data taken thus far, it can be concluded that the on-orbit HCAs are operating within their design specifications.
Author
Hollow Cathodes; International Space Station; Onboard Equipment; Contactors; Ground Tests; Space Plasmas; Electron Plasma

20030066129 ATK-Thiokol Propulsion, Brigham City, UT, USA
RSRM Case Acceptance and Refurbishment Requirements
Brinkerhoff, Gary Z.; April 10, 2003; 9 pp.; In English; AIAA 2003 Joint Propulsion Conference, Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-97238; No Copyright; Avail: CASI; A02, Hardcopy

The RSRM (Reuseable Solid Rocket Motor) Program has been developed and implemented to support manned flight space travel. The Space Shuttle Vehicle utilizes two SRBs (Solid Rocket Boosters) to assist during the launch sequence and achieve the predefined orbit and mission objectives. A critical feature of this program involves post- flight SRB retrieval, disassembly and reuse of case structural components to manufacture future RSRM motors. To ensure these components can be safely reused, inspection criteria based on dimensional, structural and fracture requirements, has been established in the form of Engineering specifications and drawings. These criteria originated from actual hardware testing (both subscale and full scale) coupled with conventional Engineering hand calculations and computerized Finite Element Analyses (FEA). The intent of this paper is to provide an overview of the RSRM Case component refurbishment requirements and the associated case hardware inspection and evaluation processes that has been established to satisfy these requirements. Many of these processes have been recently upgraded to comply with environmental regulations, obsolescence concerns and technological advancements. Qualification of these process changes has been closely monitored and documented through test plans and reports.
Author
Solid Propellant Rocket Engines; Booster Rocket Engines; Reuse

20030066142 Boeing Co., Canoga Park, CA, USA
RS-84 Engine
Stegman, E.; March 20, 2003; 1 pp.; In English; Joint Propulsion Conference, Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-01107; No Copyright; Avail: Other Sources; Abstract Only

The RS-84 is the first reusable hydrocarbon staged combustion liquid rocket engine. This engine is being developed to meet NASA s crew safety goals with a highly reliable and low cost main engine as a part of the NASA Space Launch Initiative program for the next generation reusable launch system. The NASA-MSFC and Rocketdyne team brings over 50 years of successful rocket engine development experience to meet the challenges of this new program. This team s extensive design database has been anchored with almost five decades of hydrocarbon rocket engine development and flight operations experience including Delta, Atlas, and Saturn vehicles and nearly three decades of successfully operating the world s only reusable pump-fed rocket engine, the Space Shuttle Main Engine. The team also fully benefits from the proven and experienced engineering staffs that recently completed the successful MC-1 FASTRAC , XRS-2200, and RS-68 engine development programs and the ongoing IPD and RS-76 technology development. Advances in integrated parametric design and analysis tools, advanced materials knowledge base, and state-of-the-art fabrication processes anchored and refined during the recent engine development programs are already being used by the team to design this engine.
Author
Reusable Rocket Engines; Hydrocarbon Combustion

20030066148 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Plasmoid Thruster for Space Propulsion
Koelfgen, Syri J.; Hawk, Clark W.; Eskridge, Richard; Smith, James W.; Martin, Adam K.; [2003]; 1 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: Other Sources; Abstract Only

There are a number of possible advantages to using accelerated plasmoids for in-space propulsion. A plasmoid is a compact plasma structure with an integral magnetic field. They have been studied extensively in controlled fusion research and are classified according to the relative strength of the poloidal and toroidal magnetic field (BP and Bt, respectively). An

Object with B P t >> 1 is classified as a Field Reverse Configuration (FRC); if B, = Bt, it is called a Spheromak. The plasmoid thruster operates by producing FRC-like plasmoids, and subsequently ejecting them from the device at high velocity. The plasmoid is formed inside of a single turn conical theta-pinch coil. As this process is inductive, there are no electrodes. Similar experiments have yielded plasmoid velocities of at least 50 km/s (l), and calculations indicate that velocities in excess of 100 km/s should be possible. This concept should be capable of producing Isp s in the range of 5,000 - 10,000 s with thrust densities of order 10(exp 5) N/sq m. The current experiment is designed to produce jet powers in the range of 5-10 kW, although the concept should be scalable to several MW s. The plasmoids mass and velocity will be measured with a variety of diagnostics, including internal and external B-dot probes, flux loops, Langmuir probes, high-speed cameras, and a laser interferometer. Also of key importance will be measurements of the efficiency and mass utilization. Simulations of the plasmoid thruster using MOQUI, a time dependent MHD code, will be carried out concurrently with experimental testing.
Author
Thrustors; Propulsion; Theta Pinch

20030066154 NASA Glenn Research Center, Cleveland, OH, USA
NASA GRC Stirling Technology Development Overview
Thieme, Lanny G.; Schreiber, Jeffrey G.; August 2003; 13 pp.; In English; Space Technology and Applications International Forum (STAIF-2003), 2-5 Feb. 2003, Albuquerque, NM, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 896-50-01; WBS 755-12-14
Report No.(s): NASA/TM-2003-212454; E-13976; NAs 1.15:212454; No Copyright; Avail: CASI; A03, Hardcopy

The Department of Energy, Lockheed Martin (LM), Stirling Technology Company, and NASA Glenn Research Center (GRC) are developing a high-efficiency Stirling Radioisotope Generator (SRG) for potential NASA Space Science missions. The SRG is being developed for multimission use, including providing spacecraft onboard electric power for NASA deep space missions and power for unmanned Mars rovers. NASA GRC is conducting an in- house supporting technology project to assist in developing the Stirling convertor for space qualification and mission implementation. Preparations are underway for a thermalhacuum system demonstration and unattended operation during endurance testing of the 55-We Technology Demonstration Convertors. Heater head life assessment efforts continue, including verification of the heater head brazing and heat treatment schedules and evaluation of any potential regenerator oxidation. Long-term magnet aging tests are continuing to characterize any possible aging in the strength or demagnetization resistance of the permanent magnets used in the linear alternator. Testing of the magnet/lamination epoxy bond for performance and lifetime characteristics is now underway. These efforts are expected to provide key inputs as the system integrator, LM, begins system development of the SRG. GRC is also developing advanced technology for Stirling convertors. Cleveland State University (CSU) is progressing toward a multi-dimensional Stirling computational fluid dynamics code, capable of modeling complete convertors. Validation efforts at both CSU and the University of Minnesota are complementing the code development. New efforts have been started this year on a lightweight convertor, advanced controllers, high-temperature materials, and an end-to-end system dynamics model. Performance and mass improvement goals have been established for second- and third-generation Stirling radioisotope power systems.
Author
Computational Fluid Dynamics; NASA Space Programs; Technology Utilization; General Overviews; Stirling Engines; Stirling Cycle; Systems Engineering

20030066222 NASA Marshall Space Flight Center, Huntsville, AL, USA
Design and Analysis of Turbines for Space Applications
Griffin, Lisa W.; Dorney, Daniel J.; Huber, Frank W.; June 13, 2003; 18 pp.; In English; 33rd AIAA Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA; Copyright; Avail: CASI; A03, Hardcopy

In order to mitigate the risk of rocket propulsion development, efficient, accurate, detailed fluid dynamics analysis of the turbomachinery is necessary. This analysis is used for component development, design parametrics, performance prediction, and environment definition. To support this requirement, a task was developed at NASAh4arshall Space Flight Center (MSFC) to improve turbine aerodynamic performance through the application of advanced design and analysis tools. There are four major objectives of this task: 1) to develop, enhance, and integrate advanced turbine aerodynamic design and analysis tools; 2) to develop the methodology for application of the analytical techniques; 3) to demonstrate the benefits of the advanced turbine design procedure through its application to a relevant turbine design point; and 4) to verify the optimized design and analysis with testing. The turbine chosen on which to demonstrate the procedure was a supersonic design suitable for a reusable launch vehicle (RLV). The hot gas path and blading were redesigned to obtain an increased efficiency. The redesign of the turbine was conducted with a consideration of system requirements, realizing that a highly efficient turbine that, for

example, significantly increases engine weight, is of limited benefit. Both preliminary and detailed designs were considered. To generate an improved design, one-dimensional (1D) design and analysis tools, computational fluid dynamics (CFD), response surface methodology (RSM), and neural nets (NN) were used.
Author
Turbomachinery; Design Analysis; Computational Fluid Dynamics; Performance Prediction; Dynamic Response; Aerodynamic Characteristics

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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*.

20030065636 New Hampshire Univ., Durham, NH
Pulsed Laser Deposition of Carbide Coatings for Rolling and Sliding Contact Applications
Krzanowski, James F.; Gross, Todd S.; Amato-Wierda, Carmela C.; Echt, Olof; Dec. 2003; 85 pp.; In English
Contract(s)/Grant(s): F49620-98-1-0499
Report No.(s): AD-A413458; AFRL-SR-AR-TR-03-0105; No Copyright; Avail: CASI; A05, Hardcopy

In this research program several new concepts were investigated for improving the mechanical and tribological properties of coatings intended for applications subject to repeated rolling and sliding contacts. The investigation focused on four primary areas: 1) alloying carbides to enhance coating hardness, 2) depositing composite carbide-silver coatings for reduced friction in vacuum environments, 3) evaluating carbide-metal nacreous structures for improving coating toughness, and 4) chemical vapor deposition (CVD) methods for nanostructured composite carbide coatings. Results show that, in carbide coatings, additions of silicon can provide a useful and practical route towards improving coating hardness. This is due to the disordering effect of silicon when present in transition metal carbides. Investigation of composite carbide-silver coatings demonstrated their potential as low-friction coatings in vacuum environments. In these coatings, phase separation between carbide and silver allows the silver to act as a solid lubricant, while the carbide matrix improves wear resistance over silver alone. In the third research area, the authors evaluated whether increasing film toughness by using a metal layer in TiC-based films could enhance the wear resistance of such films. Results show that the use of thin (less than 10 mm) interlayers of Chromium can significantly improve wear resistance compared to monolithic TiC. These results were obtained with a newly developed reciprocating nano-scratch test method that allows testing of a coating independent of its adhesion to the substrate. Research on CVD of TiC-based coatings evaluated three areas of thermal CVD. Finally, plasma studies were performed to explore the reactor species present during the production of hard films in a parallel plate plasma reactor. Appendix includes a report from the Systran, Inc. subcontractors and 9 of the authors' publications in peer-reviewed journals.
DTIC
Carbides; Coatings; Mechanical Properties; Pulsed Laser Deposition; Tribology; Sliding Contact

20030065640 Michigan Univ., Ann Arbor, MI
Fabrication of High-Performance Coatings Systems via a Novel In-Situ/Ex-Situ Characterization Technique
Bilello, John C.; Jul. 31, 2001; 21 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0382
Report No.(s): AD-A414044; UM-ARO-2002-110; ARO-37716.6-MS; No Copyright; Avail: CASI; A03, Hardcopy

This report will briefly outline some of the key findings made during the course of this project and some new work on the phase structure changes concomitant with the delamination behavior of Ta metallizations. Detailed accountants of prior work have been in included in previous 'Interim Reports' of this Grant and in the many technical papers that have resulted from the support of this work. A complete list of these publications is provided in Appendix II of this Final Report.
DTIC
Fabrication; Coatings; In Situ Measurement; Tantalum; Metallizing

20030065652 Gordon Research Conferences, Inc., Kingston, RI
2002 Gordon Research Conference on High Temp, Materials, Processes, and Diagnostics
Besmann, Theodore M.; May 6, 2003; 7 pp.; In English; Gordon Research Conference (GRC) on High Temperature, Materials, Processing and Diagnostics, 4-9 Aug. 2002, Waterville, ME, USA
Contract(s)/Grant(s): F49620-02-1-0355
Report No.(s): AD-A414053; AFRL-SR-AR-TR-03-0185; No Copyright; Avail: CASI; A02, Hardcopy

During this project, the development of AFM experimental expertise was undertaken. An AFM was purchased and modified for the dynamic AFM measurements. The system allows the cantilever resonance frequencies to be determined both in and out of contact with a specimen. In addition, the dynamic implementation allows the surface topography and material stiffness to be mapped simultaneously. During this project, several aspects of this research were explored. One focus was on comparison of ATM methods with other experimental measurement techniques using thin films as a test base. Improved modeling of the AFM cantilevers was undertaken as it became apparent that simpler methods were not sufficient for experimental analysis. Finite element models are being constructed to include observed variations in cantilever width, thickness, and tip location. The analytical modeling has been focused on the nonlinear vibrations of ATM cantilevers with nonlinear boundary conditions. The studies of nonlinear vibrations have been extended for contact boundary conditions of a general nature such that both soft and hard contacts may be analyzed. The method of multiple scales is the primary method used for these studies. Finally, the coupling of flexural and torsional vibration modes has been examined. The coupling is the result of the specific geometry of certain ATM cantilevers. Both experimental and analytical studies have been conducted.
DTIC
Conferences; Mathematical Models; High Temperature; Coatings; Composite Materials

20030065713 Princeton Univ., NJ, USA
Investigations of Crystalline Organic Nanostructures Grown by Ultra-High Vacuum and Vapor Phase Techniques
Forrest, Stephen; September 1999; 4 pp.; In English
Contract(s)/Grant(s): F49620-96-1-0277; Proj-2305
Report No.(s): AD-A413036; AFRL-SR-AR-TR-03-0081; No Copyright; Avail: CASI; A01, Hardcopy

We demonstrated the highly oriented growth of an organic salt using the new process of low pressure organic vapor phase deposition (LP-OVPD). This follows on our earlier work in the demonstration of atmospheric pressure OVPD. In the kinetic regime of LP-OVPD, however, there is improved surface morphology and crystalline alignment, to the point that we can now routinely achieve the alignment of DAST thin films across entire wafer surfaces. The material is excellent for optical modulators. We are currently investigating a modulator design which employs titanium dioxide waveguides coated with oriented DAST films. The wave propagating in the waveguide is evanescently coupled into the organic film which can be used to shift the phase of the wave by application (through electrodes) of an electric field. One milestone for the coming year is to demonstrate low voltage DAST-based phase modulators grown using LP-OVPD. This work is being published as an invited paper in Advanced Materials.
DTIC
Organic Materials; Salts; Nanostructures (Devices)

20030065734 Georgia Inst. of Tech., Atlanta, GA
State-Switched Absorber/Damper for Structural Control
Cunefare, Kenneth A.; Dec. 17, 2002; 15 pp.; In English
Contract(s)/Grant(s): DAAD19-99-1-0376
Report No.(s): AD-A414175; SSA02; ARO-38955.1-EG; No Copyright; Avail: CASI; A03, Hardcopy

This project investigated a novel variation on the concept of a tuned vibration absorber or damper: the State-Switched Absorber (SSA). The SSA is capable of altering its stiffness state nearly instantaneously. The change in stiffness causes a change in the resonance frequencies of the system thereby instantaneously retuning the SSA to a new frequency. The state-switching technique increases the effective bandwidth of the absorber can be made to be effective against multiple frequencies within its bandwidth and in addition; holds forth the potential for unique applications such as the preferential 'pumping' of energy into the absorber. The project yielded modeling methods for the absorber applied to common structural elements e.g. beams and plates; switching rules for actuators; analysis methods for placement and optimization; SSA prototypes; control circuit implementations, and experimental validation of state-witched absorbers.
DTIC
Vibration Damping; Absorbers (Materials); Control Systems Design; Structural Design; Switching Circuits

20030065896 Applied Research Associates, Inc., Englewood, CO, USA
Response Modeling of Lightweight Charring Ablators and Thermal Radiation Testing Results
Congdon, William M.; Curry, Donald M.; Rarick, Douglas A.; Collins, Timothy J.; July 21, 2003; 38 pp.; In English; AIAA Joint Propulsion Conference and Exhibit 2003, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-03045
Report No.(s): AIAA Paper 2003-4657; Copyright; Avail: CASI; A03, Hardcopy

Under NASA's In-Space Propulsion/Aerocapture Program, ARA conducted arc-jet and thermal-radiation ablation test series in 2003 for advanced development, characterization, and response modeling of SRAM-20, SRAM-17, SRAM-14, and PhenCarb-20 ablators. Testing was focused on the future Titan Explorer mission. Convective heating rates (CW) were as high as 153 W/sq cm in the IHF and radiation rates were 100 W/sq cm in the Solar Tower Facility. The ablators showed good performance in the radiation environment without spallation, which was initially a concern, but they also showed higher in-depth temperatures when compared to analytical predictions based on arc-jet thermal-ablation response models. More testing in 2003 is planned in both of these facility to generate a sufficient data base for Titan TPS engineering.
Author
Ablative Materials; Thermal Protection; High Temperature Tests; Protective Coatings; Models; Heat Shielding; Data Acquisition; Prediction Analysis Techniques

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COMPOSITE MATERIALS

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

20030065633 Rensselaer Polytechnic Inst., Troy, NY
Models for Damage-Resistant Design of Composite Structures
Dvorak, George J.; Aug. 30, 2002; 15 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0464
Report No.(s): AD-A414027; ARO-38324.10-EG; No Copyright; Avail: CASI; A03, Hardcopy

The principal goal of this research is development of new techniques leading to improvement of damage and penetration resistance of laminated composite structures, such as Army vehicles and their armor. The focus is on control and retardation of damage and fracture in fibrous composites, through modified fabrication procedures that include fiber prestress that can be applied with available filament winding or fiber placement equipment. Novel optimization techniques were used to find fiber prestress magnitudes in individual plies, that accommodate loading-induced ply and local stresses within initial and subsequent damage envelopes both inside and at laminate free edges. Stress relaxation in prestressed laminates with viscoelastic matrices, together with creep deformation under constant rate loading or large changes in temperature are included in our results. Applications of fiber prestress have been identified and explored in compressive prestressing of ceramic/FRp armor plates for improved resistance to projectile penetration. Design of composite-reinforced gun barrels can also be performed using the results of this investigation.
DTIC
Damage; Composite Structures; Fabrication; Military Vehicles; Mathematical Models

20030065816 Texas Univ., Dallas, TX, USA
Tunable Photonic Nanostructures 2: Semi-Transparent Metallic Opal Replicas and Nanocomposites
Jul. 2001; 20 pp.; In English; Proceedings of Enrico Fermi School 'Organic Nanostructures', Jul. 2001, Varenna, Italy; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-1-0316
Report No.(s): AD-A413975; No Copyright; Avail: CASI; A03, Hardcopy

The same free electron plasma that causes usual metals to be conducting also causes them to be non-transmissive to electromagnetic waves. As well known at frequency (omega) below the plasma frequency (omega)p), the dielectric permittivity (Epsilon = 1 - (omega p/omega)squared) becomes negative and the refractive index (n(omega) = (epsilon mu))(exp 1/2) where mu is the magnetic permeability) becomes imaginary. Therefore, electromagnetic waves can not effectively propagate inside metals, but are instead reflected for good metals and both reflected and absorbed for less conductive metals. This point emphasizes that high transparency (T) and high electrical conductivity (sigma) are contradictory properties, and that the product T x sigma can not be maximized in the usual bulk materials found in nature. The motivation of the present work was to create photonic crystals (PC), not of conventional dielectric type 1- 2, but of metallic periodic nanostructures or metallo-dielectric nanocomposite PC in which T x sigma can be maximized. Moreover optical and electronic properties can be made tunable because of the utilization of geometry and topology of interpenetrating components separated by a large interfacial area A(sub upsilon) in a photonic crystal structure.
DTIC
Photonics; Tuning; Nanostructures (Devices)

20030065962 NASA Glenn Research Center, Cleveland, OH, USA

Implementation of an Associative Flow Rule Including Hydrostatic Stress Effects Into the High Strain Rate Deformation Analysis of Polymer Matrix Composites

Goldberg, Robert K.; Roberts, Gary D.; Gilat, Amos; June 2003; 27 pp.; In English

Contract(s)/Grant(s): WBS 22-708-24-05

Report No.(s): NASA/TM-2003-212382; E-13959; NAS 1.15:212382; Copyright; Avail: CASI; A03, Hardcopy

A previously developed analytical formulation has been modified in order to more accurately account for the effects of hydrostatic stresses on the nonlinear, strain rate dependent deformation of polymer matrix composites. State variable constitutive equations originally developed for metals have been modified in order to model the nonlinear, strain rate dependent deformation of polymeric materials. To account for the effects of hydrostatic stresses, which are significant in polymers, the classical J2 plasticity theory definitions of effective stress and effective inelastic strain, along with the equations used to compute the components of the inelastic strain rate tensor, are appropriately modified. To verify the revised formulation, the shear and tensile deformation of two representative polymers are computed across a wide range of strain rates. Results computed using the developed constitutive equations correlate well with experimental data. The polymer constitutive equations are implemented within a strength of materials based micromechanics method to predict the nonlinear, strain rate dependent deformation of polymer matrix composites. The composite mechanics are verified by analyzing the deformation of a representative polymer matrix composite for several fiber orientation angles across a variety of strain rates. The computed values compare well to experimentally obtained results.

Author

Deformation; Hydrostatics; Micromechanics; Polymer Matrix Composites; Strain Rate; Viscoplasticity; Mathematical Models; Flow Distribution

20030066113 ATK-Thiokol Propulsion, Brigham City, UT, USA

High Temperature Permeability of Carbon Cloth Phenolic Composite

Park, O. Y.; Lawrence, T. W.; July 2003; 8 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-97238

Report No.(s): AIAA Paper 2003-5242; Copyright; Avail: CASI; A02, Hardcopy

The carbon fiber phenolic resin composite material used for the RSRM nozzle insulator occasionally experiences problems during operation from pocketing or spalling-like erosion and lifting of plies into the char layer. This phenomenon can be better understood if the permeability of the material at elevated temperatures is well defined. This paper describes an experimental approach to determining high temperature permeability of the carbon phenolic material used as the RSRM nozzle liner material. Two different approaches were conducted independently using disk and bar type specimens with the designed permeability apparatus. The principle of the apparatus was to subject a test specimen to a high pressure differential and a heat supply and to monitor both the pressure and temperature variations resulting from gas penetration through the permeable wall between the two chambers. The bar types, especially designed to eliminate sealing difficulties at a high temperature environment, were directly exposed to real time temperature elevation from 22 C to 260 C during the test period. The disk types were pre-heat treated up to 300 C for 8 hours and cooled to room temperature before testing. Nonlinear variation of downstream pressure at a certain temperature range implied moisture release and matrix pyrolysis. Permeability was calculated using a semi-numerical model of quasi-steady state. The test results and the numerical model are discussed in the paper.

Author

Carbon Fibers; Phenolic Resins; High Temperature; Permeability; Fabrics; Woven Composites

20030066159 NASA Marshall Space Flight Center, Huntsville, AL, USA

Analysis of a Preloaded Bolted Joint in a Ceramic Composite Combustor

Hissam, D. Andy; Bower, Mark V.; [2003]; 11 pp.; In English; AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A03, Hardcopy

This paper presents the detailed analysis of a preloaded bolted joint incorporating ceramic materials. The objective of this analysis is to determine the suitability of a joint design for a ceramic combustor. The analysis addresses critical factors in bolted joint design including preload, preload uncertainty, and load factor. The relationship between key joint variables is also investigated. The analysis is based on four key design criteria, each addressing an anticipated failure mode. The criteria are defined in terms of margin of safety, which must be greater than zero for the design criteria to be satisfied. Since the proposed

joint has positive margins of safety, the design criteria are satisfied. Therefore, the joint design is acceptable.
Author
Bolted Joints; Ceramics; Combustion Chambers

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INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

20030065611 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Experimental Results for a High Swirl, Ultra Compact Combustor for Gas Turbine Engines
Quaale, Ryan J.; Mar. 2003; 131 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412863; AFIT/GAE/ENY/03-5; No Copyright; Avail: CASI; A07, Hardcopy

Laser Doppler Velocimeter (LDV) experiments have been conducted within the cavity of an atmospheric pressure, small scale, Ultra Compact Combustor (UCC). The UCC uses highly swirled flow in a cavity around the outside periphery of the combustor to generate high centripetal acceleration in the fluid. This enhances mixing and leads to a very short axial flame length. Additionally, due to the circumferential velocity, much of the residence time required by the flame is provided by the circumference of the engine rather than axial length as in conventional combustors.
DTIC
Gas Turbines; Combustion Chambers

20030065632 Illinois Univ., Urbana, IL
Analytical Modelling of Ignition of Condensed Energetic Materials, Pulsed Detonation Engines and Miniaturization of Explosive Systems: Final Report
Short, Mark; Stewart, Scott; Jan. 14, 2003; 7 pp.; In English
Contract(s)/Grant(s): F49620-00-1-0005
Report No.(s): AD-A413447; AFRL-SR-AR-TR-03-0149; No Copyright; Avail: CASI; A02, Hardcopy

Over the duration of the grant, several papers were written by Short, his collaborators and students on AFOSR issues related to the proposal outline. Those that list whole or partial support of the AFOR (F49620-00-1-0005) are given below. Copies of the publications listed are also included. Some highlights of the most recent work are also included.
DTIC
Miniaturization; Detonators

20030065718 Oklahoma Univ., Norman, OK
Mesostructural Intercalation Cathodes
Frech, Roger; Sep. 3, 2002; 16 pp.; In English
Contract(s)/Grant(s): DAAH55-98-1-0252
Report No.(s): AD-A414024; FINAL REPORT-1; ARO-37271.3-CH; No Copyright; Avail: CASI; A03, Hardcopy

Mesoporous intercalation electrode materials were prepared, characterized, and their electrochemical performance evaluated. The usual characterization techniques were complemented by our (novel!) use of electron microprobe analysis to examine the homogeneity of the products. The results show that in many cases, oxidation/reduction does not significantly alter the local structure about the electroactive metal ions in these relatively open structures, thus increasing the electrochemical reversibility. These structures also appear to facilitate ionic diffusion. Well-ordered mesoporous SnO and SnO2 were successfully prepared and exhibited higher specific capacities than the carbon materials presently used in the anodes of lithium ion batteries. These materials clearly have potential application as intercalation anode materials. The cycling behavior of manganese and vanadium substituted into a mesoporous host aluminophosphate framework showed very good reversibility, while rate capacity studies indicated excellent capacity retention. It is clear that the open mesoporous host structures facilitate the transport of lithium ions through the framework. The University provided funds to purchase an x-ray system in support of this work, with the provision that it be shared with other scientists on campus. Although no ARO funds were used for the purchase, the grant support from ARO played a major role in this acquisition.
DTIC
Cathodes; Intercalation; Electrochemistry; Porosity

20030065748 Lehigh Univ., Bethlehem, PA

Determination of SiO2 Mechanical Behavior Via High Temperature Microtensile Testing

Vinci, R.; Delph, T.; Jaccodine, R.; Jan. 2001; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAD19-01-1-0662

Report No.(s): AD-A413920; No Copyright; Avail: CASI; A03, Hardcopy

The goal of this STIR project was to develop and demonstrate the capability to carry out the first direct determination of the mechanical properties of SiO2 thin films at typical oxidation temperatures and stresses. There is little doubt that time-dependent inelastic deformation plays a significant role in SiO2 films. There are various ways of obtaining mechanical properties data, but the most direct and the least ambiguous in interpretation is testing under uniaxial loading. Unfortunately testing specimens of bulk vitreous SiO2 is not sufficient because this material is believed to have mechanical properties that differ from those of thermally grown SiO2. Our approach was to conduct tensile tests on microscopic specimens of thermally grown SiO2 from which the silicon substrate has been chemically removed. The four stages of the project were to fabricate thin SiO2 specimens, to test the specimens at room temperature, to demonstrate a high temperature furnace compatible with the tensile tester, and to acquire a demonstration measurement of the high temperature mechanical behavior of SiO2. The first three stages of the project were successfully completed. The fourth stage, demonstration of high temperature measurement, was attempted but could not be completed within the time frame of the project.

DTIC

Thin Films; Oxidation; Silicon

20030065749 NASA Ames Research Center, Moffett Field, CA, USA

Renal Osteodystrophy in the Dahl Salt-Sensitive Rat

Arnaud, S. B.; Zerath, E.; Cephas, S.; DePaoli, A.; Savayongsa, P.; Thierry-Palmer, M.; [2003]; 1 pp.; In English; Twelfh Workshop on Vitamin D, 6-10 Jul. 2003, Maastricht, Netherlands; Copyright; Avail: Other Sources; Abstract Only

The Dahl salt-sensitive rat (SS) is a genetic model for human salt-sensitive hypertension in which we have found low circulating 25-hydroxyvitamin D (25-D) during high salt intake. We have reported deteriorating renal function with aging in one year-old S rats fed normal salt diets primarily (ASBMR, 2002). Kidneys were enlarged compared to salt-resistant (SR) controls and showed extensive nephrosclerosis and tubular atrophy, lesions not found in SR rats of the same age. The impairment in creatinine clearance was modest. Changes in the calcium endocrine system with aging in SS males were slight hypocalcemia, secondary hyperparathyroidism, low plasma 25-D and 24,25-D, and normal plasma 1,25-D. Significant 25-D, 25-D binding activity, and proteinuria three times that in the urine of SR rats, may have contributed to the low plasma 25-D and 24,25-D in SS rats. This study was undertaken to determine whether there was significant bone disease in this same group of rats. Ten SS and 13 SR rats were given calcein, 15 mg/kg, SQ, 7 and 3 days prior to necropsy for quantitative histomorphometry of the right tibia. The right femur was analyzed for mineral content. Ash weights were lower in SS than in SR femurs (470 plus or minus 22 vs. 497 plus or minus 25, p less than 0.01). Tibial bone volume was 12 plus or minus 3% of total volume in SS, but 17 plus or minus 2% in SR (p less than 0.001) and SS rats had fewer trabeculae. Osteoblasts covered three times the bone surface in SS as in SR tibiae and osteoclasts nearly twice the bone surface. Mineral apposition rates were delayed in SS compared to SR (1.6 plus or minus 0.3 vs. 1.3 plus or minus 0.1 um/d, p less than .003). There is clear evidence of bone disease in the male one-year old Dahl SS rats fed primarily normal salt diets. The main features of this bone disease incriminate the renal loss of 25-D, consequent low vitamin D status and secondary hyperparathyroidism in its pathogenesis.

Author

Renal Function; Salts; Sensitivity; Rats; Diseases; Genetics

20030065772 Canadian Commercial Corp., Ottawa, Ontario, Canada

Mediation of Sulfur Mustard Cellular Toxicity by ATP: A Possible Mechanism of Action of Sulfur Mustard Toxicity

Lundy, Paul; Frew, R.; Vair, C.; Nelson, P.; Gong, W.; Dec. 2002; 176 pp.; In English

Contract(s)/Grant(s): DAMD17-99-2-9010

Report No.(s): AD-A412934; No Copyright; Avail: CASI; A09, Hardcopy

The effect of HD on cell death was examined in a variety of tests in a number of phylogenetically distinct cell types. HD caused concentration dependant apoptosis with increasing numbers of necrotic cells at higher concentrations. A variety of techniques were used to examine HD induced cellular biochemical responses in attempts to identify a critical determinant of initiation of these events. Much of the work describes attempts to relate HD induced changes in intracellular calcium levels with cell death and also to determine the role of cell surface ionotropic ATP receptors (calcium pores), which when stimulated might be responsible for the calcium influx since upon stimulation they mimicked many of the apoptotic effects of HD.

Examination of the intracellular biochemical events known to be related to induction of apoptosis such as the role of certain caspases and DNA were also carried out. Some studies describe the characterization of a cytolytic pore complex in certain cells and the effects of HD on this pore. Other studies were prompted by our initial findings of the importance of cationic environment on ATP toxicity. This work identified the extreme importance of ionic environment (including pH) on HD toxicity.
DTIC
Toxicity; Sulfur

20030065777 Air Force Research Lab., Edwards AFB, CA, USA
Monofunctional Aminophenyl Polyhedral Oligomeric Silsesquioxanes - A Model for High Performance Nanocomposite Monomers
Gonzalez, Rene I.; Viers, Brent D.; Haddad, Timothy; Mar. 26, 2002; 24 pp.; In English; Materials Research Society Meeting, 1-5 Apr. 2002
Contract(s)/Grant(s): Proj-4847
Report No.(s): AD-A411127; AFRL-PR-ED-TP-2002-070; No Copyright; Avail: CASI; A03, Hardcopy

An aminophenyl functionalized polyhedral silsesquioxane (POSS) was synthesized as a model monofunctional organic-inorganic hybrid monomer. A multistep procedure whereby an incompletely condensed POSS triol scaffold was 'corner capped' with phenyltrichlorosilane and then the phenyl moiety was nitrated and subsequently reduced with Zn/HCl to form the desired AMINOPHENYLPOSS (POSS aniline). Mononitration and quantitative reduction to a monoamine was observed. Furthermore, the amine was isolated as the free base, and not as a salt. However, 1H COSY NMR spectroscopy indicates that a variety of POSS aniline isomers are formed, ortho disubstitution most prevalent (57%), with meta (38%), and para (5%).
DTIC
Synthesis (Chemistry); Nanocomposites; Oligomers; Monomers

20030065838 NASA Marshall Space Flight Center, Huntsville, AL, USA
Structural Basis for 'Flip-Flop' Action of Human Pyruvate Dehydrogenase
Ciszak, Ewa; Korotchkina, Lioubov; Dominiak, Paulina; Sidhu, Sukhdeep; Patel, Mulchand; [2003]; 1 pp.; In English; American Crystallographic Association Meeting, 26-31 Jul. 2003, Cincinnati, OH, USA; Copyright; Avail: Other Sources; Abstract Only

The derivative of vitamin B1, thiamin pyrophosphate is a cofactor of pyruvate dehydrogenase, a component enzyme of the mitochondrial pyruvate dehydrogenase multienzyme complex that plays a major role in directing energy metabolism in the cell. This cofactor is used to cleave the C(sup alpha)-C(=O) bond of pyruvate followed by reductive acetyl transfer to lipoyl-dihydrolipoamide acetyltransferase. In alpha(sub 2)beta(sub 2)-tetrameric human pyruvate dehydrogenase, there are two cofactor binding sites, each of them being a center of independently conducted, although highly coordinated enzymatic reactions. The dynamic nonequivalence of two, otherwise chemically equivalent, catalytic sites can now be understood based on the recently determined crystal structure of the holo-form of human pyruvate dehydrogenase at 1.95A resolution. The structure of pyruvate dehydrogenase was determined using a combination of MAD phasing and molecular replacement followed by rounds of torsion-angles molecular-dynamics simulated-annealing refinement. The final pyruvate dehydrogenase structure included coordinates for all protein amino acids two cofactor molecules, two magnesium and two potassium ions, and 742 water molecules. The structure was refined to R = 0.202 and R(sub free) = 0.244. Our structural analysis of the enzyme folding and domain assembly identified a simple mechanism of this protein motion required for the conduct of catalytic action.
Author
Enzymes; Enzyme Activity; Acetyl Compounds; Pyruvates; Catalytic Activity; Amino Acids

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METALS AND METALLIC MATERIALS

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

20030065634 Naval Research Lab., Bay Saint Louis, MS
The Role of Fungi in Microbiologically Influenced Corrosion
Little, Brenda J.; Ray, Richard I.; Sep. 2002; 11 pp.; In English
Report No.(s): AD-A414034; NRL/PP/7302-02-0006; No Copyright; Avail: CASI; A03, Hardcopy

Case histories of microbiologically influenced corrosion are presented with an emphasis on failure analysis and the techniques for diagnosing the role of fungi in the corrosion. Fungal influenced corrosion has been reported for carbon steel and aluminum fuel tanks; carbon steel cables; and painted and unpainted ship holds containing wet and dry cargos. Deterioration of fiber-reinforced composites and glass has also been attributed to fungal species.
DTIC
Corrosion; Fungi; Microbiology; Failure Analysis

20030065644 Carnegie-Mellon Univ., Pittsburgh, PA
Advanced Magnetic Materials for Aircraft Power Applications
McHenry, Michael E.; Laughlin, David E.; Majetich, Sara A.; Piehler, Henry R.; Rollett, Anthony; Mar. 4, 2003; 14 pp.; In English
Contract(s)/Grant(s): F49620-96-1-0454
Report No.(s): AD-A413459; AFRL-SR-AR-TR-03-0095; No Copyright; Avail: CASI; A03, Hardcopy

A multidisciplinary team of Carnegie Mellon University (CMU) researchers with substantial support from the public and private sectors was assembled to develop new materials with improved magnetic and mechanical properties at high temperature. The group worked on the refinement of existing soft bulk materials while conducting research on novel nanocrystalline magnets in parallel. The team also studied existing and new high temperature permanent magnetic materials for use in aircraft engine applications. A vigorous search for new magnetic materials, both hard and soft, was conducted. Prototypes for bulk soft magnets were Fe-Co alloys. The effects of alloy grain size, structural order, orientation, and texture were studied to maximize induction and permeability, and minimize hysteretic and eddy current losses at elevated temperatures. Investigation of nanocrystalline materials for soft magnetic applications proceeded on two fronts: plasma synthesis of magnetic nanoparticles followed by the use of compaction techniques to form dense magnets, and the nanocrystallization of amorphous precursors to produce exchange coupled magnetic nanocrystals. The first effort has led to the synthesis of metallic nanoparticles, of new core shell structures, and nanocrystalline ferrites. The second effort has led to the discovery of a new nanocrystalline soft magnetic material called HITPERM on which work continues to explore its use in power electronic applications. For hard magnetic materials capable of operating at up to 400 degrees, the team investigated Co-containing 2:17, 1:12, and 3:29-based permanent magnet materials. They investigated the fundamental properties of these alloy systems as well as processing protocols for engineering optimal microstructures for hard magnetic properties. Co-containing 3:29 phase magnets have extended the temperature range of these materials. Rapid solidification was used to tailor microstructure and harness anisotropy.
DTIC
Aircraft Engines; Magnetic Materials; Mechanical Properties; High Temperature; Nanocrystals

20030065727 Naval Academy, Annapolis, MD
The Influence of Crystal Orientation on the Corrosion Behavior of Aluminum
Davis, Brandon W.; Jan. 1997; 107 pp.; In English
Report No.(s): AD-A414131; USNA-TSPR-245(1997); No Copyright; Avail: CASI; A06, Hardcopy

Observations have been made which indicate that the pitting of aluminum is crystallographic. When pure aluminum pits, the resulting morphology of the pit is composed of (100) orientations. Metastable and stable pitting was examined for (100), (110), and (111) aluminum single crystals and polycrystalline aluminum with 99.99% purity. Evidence was seen that the (111) orientation had a higher affinity for initiation and propagation and the (100) orientation had the least affinity for these mechanisms.
DTIC
Aluminum; Corrosion; Crystallography; Crystal Structure

20030065744 California Univ., Berkeley, CA
First Principles Predictions of Gun Tube Erosion Chemistry and Possible Protective Coatings
Carter, Emily A.; Sep. 2002; 16 pp.; In English
Contract(s)/Grant(s): DAAD9-99-1-0227
Report No.(s): AD-A413919; ARO-40051.10-CH; No Copyright; Avail: CASI; A03, Hardcopy

Increasing the service lifetime of military machinery will improve logistics in the field (less down-time due to maintenance or replacement) and will free up resources for other pressing needs. To this end, the Army has a vested interest in enhancing the lifetime of gun barrels, which are limited currently by erosion of the steel from which the gun barrels are

made. However, it is exceedingly difficult to determine experimentally in situ the mechanisms of erosion. Therefore, computer simulations can help elucidate those mechanisms and in ultimately extending the lifetime of gun barrels by discovering new ways to inhibit erosion.
DTIC
Erosion; Gun Launchers

20030065832 NASA Marshall Space Flight Center, Huntsville, AL, USA
Vertical Electron Transport through PbS-EuS Structures
Wrotek, S.; Dybko, K.; Morawski, A.; Makosa, A.; Wosinski, T.; Figielski, T.; Tkaczyk, Z.; Lusakowska, E.; Story, T.; Sipatov, A. Yu, et al.; [2003]; 1 pp.; In English
Contract(s)/Grant(s): NAS8-02096; Copyright; Avail: Other Sources; Abstract Only

Temperature dependence of current-voltage I-V characteristics and resistivity is studied in ferromagnetic PbS-EuS semiconductor tunnel structures grown on n-PbS (100) substrates. For the structures with a single (2-4 nm thick) ferromagnetic EuS electron barrier we observe strongly non-linear I-V characteristics with an effective tunneling barrier height of 0.3-0.7 eV. The experimentally observed non-monotonic temperature dependence of the (normal to the plane of the structure) electrical resistance of these structures is discussed in terms of the electron tunneling mechanism taking into account the temperature dependent shift of the band offsets at the EuS-PbS heterointerface as well as the exchange splitting of the electronic states at the bottom of the conduction band of EuS.
Author
Temperature Dependence; Lead Sulfides; Semiconductors (Materials); Europium Compounds

20030065908 NASA Marshall Space Flight Center, Huntsville, AL, USA
In-Situ Pressure Measurements During the Detached Growth of Germanium
Volz, M. P.; Palosz, W.; Szofran, F. R.; [2003]; 1 pp.; In English; Microgravity Transport Processes in Fluid, Thermal, Biological and Materials Sciences Conference III, 14-19 Sep. 2003, Davos, Switzerland; Copyright; Avail: Other Sources

Crystal growth by the vertical Bridgman method in which there is little or no contact between the wall and the crystal has been termed detached solidification. Detachment has been observed frequently in previous microgravity experiments, and has been reported under some terrestrial conditions as well. It is expected that detachment can be conditioned by establishing an appropriate pressure difference below and above the melt. To test this hypothesis, an experimental technique has been developed to measure this pressure difference during the growth of germanium by the vertical Bridgman method. The apparatus allows for both monitoring the pressures and actively controlling them during growth. For a given melt height, there is a maximum pressure difference attainable before gas bubbles up through the melt. This maximum pressure increases with increasing melt height. As the melt height approaches zero, the maximum pressure difference, about 20 mbar in these experiments, is determined by the surface tension and gap width of the meniscus at the bottom of the melt.
Author
Crystal Growth; Pressure Measurement; Germanium; Bridgman Method; Microgravity

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NONMETALLIC MATERIALS

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

20030065628 SRI International Corp., Menlo Park, CA
Heel-Strike Generator Using Electrostrictive Polymers
Pelrine, Ronald E.; Aug. 2002; 5 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAG55-98-K-0001; Proj-3494
Report No.(s): AD-A414020; ITAD-3494-FR-02-123; ARO-38970.1-CH; No Copyright; Avail: CASI; A01, Hardcopy

SRI investigated ways to harvest otherwise wasted energy from walking. The recovered energy, potentially on the order of 1-2 W per boot, can be used by a soldier to supplement battery power, as an emergency backup source of power, for specialized on-board boot functions such as inertia navigation, and, in the future, to enhance walking and other mobility performance. The approach used by SRI was electroactive polymers (EAP's), rubbery materials that generate electrical power when stretched and contracted. There were five major results of the project including (1) demonstration that non-piezo EAP's can be used as powerful generator materials and development of supporting theory and experiment, (2) development and

demonstration of boot generators capable of generating up to 0.8 J/step of energy, (3) development of several mechanical boot generator designs and their associated EAP fabrication techniques, (4) development of boot generator electronics and identification of areas for future work needed for miniaturization, and (5) technology transfer including a follow-on project with a manufacturer to develop a commercial product.
DTIC
Electroactive Polymers; Generators; Boots (Footwear); Fabrication; Human Factors Engineering

20030065661 NASA Marshall Space Flight Center, Huntsville, AL, USA
Modeling Tetragonal Lysozyme Crystal Growth Rates
Gorti, Sridhar; Forsythe, Elizabeth L.; Pusey, Marc L.; [2003]; 1 pp.; In English; American Crystallographic Association (ACA) Meeting, 26-30 Jul. 2003, Covington, KY, USA; Copyright; Avail: Other Sources; Abstract Only

Tetragonal lysozyme 110 face crystal growth rates, measured over 5 orders of magnitude in range, can be described using a model where growth occurs by 2D nucleation on the crystal surface for solution supersaturations of c/c(sub eq) less than or equal to 7 +/- 2. Based upon the model, the step energy per unit length, beta was estimated to be approx. 5.3 +/- 0.4 x 10(exp -7) erg/mol-cm, which for a step height of 56 A corresponds to barrier of approx. 7 +/- 1 k(sub B)T at 300 K. For supersaturations of c/c(sub eq) > 8, the model emphasizing crystal growth by 2D nucleation not only could not predict, but also consistently overestimated, the highest observable crystal growth rates. Kinetic roughening is hypothesized to occur at a cross-over supersaturation of c/c(sub eq) > 8, where crystal growth is postulated to occur by a different process such as adsorption. Under this assumption, all growth rate data indicated that a kinetic roughening transition and subsequent crystal growth by adsorption for all solution conditions, varying in buffer pH, temperature and precipitant concentration, occurs for c/c(sub eq)(T, pH, NaCl) in the range between 5 and 10, with an energy barrier for adsorption estimated to be approx. 20 k(sub B)T at 300 K. Based upon these and other estimates, we determined the size of the critical surface nucleate, at the crossover supersaturation and higher concentrations, to range from 4 to 10 molecules.
Author
Lysozyme; Protein Crystal Growth; Models; Nucleation; Supersaturation

20030065750 North Carolina State Univ., Raleigh, NC
Thermophysical Properties and Phase Equilibria of Materials Systems
Reeber, R. R.; Brenner, D.; Wang, K.; Prater, John; Jun. 27, 2002; 5 pp.; In English
Contract(s)/Grant(s): DAADH04-93-D-0003
Report No.(s): AD-A413930; ARO-36219.16-MS-SR; No Copyright; Avail: CASI; A01, Hardcopy

The objective is to improve thermal expansion, specific heat, molar volume, and bulk moduli predictions at the highest temperatures and pressures. In those regions experiments are difficult and data is often marginally reliable. In a series of papers, we have developed models for predicting these properties for a wide range of metals, ceramics and semiconductors. By considering the influence of thermal defects on thermal expansion it has been possible to provide a quantitative relationship for thermal expansion and molar volume from near absolute zero to the melting point for refractory metals aluminum and copper. Over the course of the project we have combined our improved properties with finite element methods to calculate residual stresses important for the fabrication and reliability of group Ill-V Nitride devices and tungsten carbide.
DTIC
Thermal Expansion; Finite Element Method

20030065803 Tennessee Univ., Knoxville, TN
Melt Blown Fabrics for Chemical Protective Liners
Wadsworth, Larry C.; Lee, Youn E.; April 2003; 33 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0732
Report No.(s): AD-A413982; ASBCC/SSC-TR-03/021; No Copyright; Avail: CASI; A03, Hardcopy

Novel melt blown fabrics were processed from thermoplastic polyurethanes (TPU) using both a 6-inch and a 20-inch melt blowing (MB) line at the University of Tennessee's Textile and Nonwovens Development Center (TANDEC) These nonwovens were developed to determine the processing conditions to produce the finest fiber and most uniform nonwoven fabrics possible with TPUs to be potential candidate fabrics for new chemical protective clothing designs This study was performed in three phases The objective of Phase 1 was to establish an envelope of MB operating conditions versus web performance properties with three TPUs having different breathability and elasticity properties The objective of Phase 2 was to use this information to optimize the processing conditions of the 20-inch MB line through the evaluation of the web barrier

and strength properties. Another focus of Phase 2 was to determine the extent to which polymer throughput rate could be increased, while maintaining acceptably small fiber diameters and other key performance attributes to improve processing economics. Phase 3 of this Scientific and Technical Innovation Research (STIR) project involved the designing of a novel high performance melt blown line with an addition port positioned at the end of a twin screw extruder, ahead of the die, to facilitate coprocessing of new additives for protective fabrics.
DTIC
Thermoplastic Resins; Polyurethane Resins; Protective Clothing; Chemical Warfare

20030065931 NASA Marshall Space Flight Center, Huntsville, AL, USA
Towards the Structure Determination of a Modulated Protein Crystal: The Semicrystalline State of Profilin:Actin
Borgstahl, G.; Lovelace, J.; Snell, E. H.; Bellamy, H.; [2003]; 1 pp.; In English; American Crystallographic Association, 26-31 Jul. 2003, Covington, KY, USA
Contract(s)/Grant(s): NCC-866; No Copyright; Avail: Other Sources; Abstract Only

One of the remaining challenges to structural biology is the solution of modulated structures. While small molecule crystallographers have championed this type of structure, to date, no modulated macromolecular structures have been determined. Modulation of the molecular structures within the crystal can produce satellite reflections or a superlattice of reflections in reciprocal space. We have developed the data collection methods and strategies that are needed to collect and analyze these data. If the macromolecule's crystal lattice is composed of physiologically relevant packing contacts, structural changes induced under physiological conditions can cause distortion relevant to the function and biophysical processes of the molecule making up the crystal. By careful measurement of the distortion, and the corresponding three-dimensional structure of the distorted molecule, we will visualize the motion and mechanism of the biological macromolecule(s). We have measured the modulated diffraction pattern produced by the semicrystalline state of profilin:actin crystals using highly parallel and highly monochromatic synchrotron radiation coupled with fine phi slicing (0.001-0.010 degrees) for structure determination. These crystals present these crystals present a unique opportunity to address an important question in structural biology. The modulation is believed to be due to the formation of actin helical filaments from the actin beta ribbon upon the pH-induced dissociation of profilin. To date, the filamentous state of actin has resisted crystallization and no detailed structures are available. The semicrystalline state profilin:actin crystals provides a unique opportunity to understand the many conformational states of actin. This knowledge is essential for understanding the dynamics underlying shape changes and motility of eukaryotic cells. Many essential processes, such as cytokinesis, phagocytosis, and cellular migration depend upon the capacity of the actin microfilament system to be restructured in a controlled manner via polymerization, depolymerization, severing, cross-linking, and anchorage. The structure the semicrystalline state of profilin:actin will challenge and validate current models of muscle contraction and cell motility. The methodology and theory under development will be easily extendable to other systems.
Author
Macromolecules; Crystal Structure; Diffraction Patterns; Synchrotron Radiation; Monochromatic Radiation; Distortion; Proteins

20030065946 Luna Innovations, Inc., Blacksburg, VA, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA
Rotationally Molded Liquid Crystalline Polymers
Rogers, Martin; Stevenson, Paige; Scribben, Eric; Baird, Donald; Hulcher, Bruce; February 2002; 6 pp.; In English; 14th International Conference on Composite Materials, 14-18 Jul. 2003, San Diego, CA, USA
Contract(s)/Grant(s): NAS8-02111; Copyright; Avail: CASI; A02, Hardcopy

Rotational molding is a unique process for producing hollow plastic parts. Rotational molding offers advantages of low cost tooling and can produce very large parts with complicated shapes. Products made by rotational molding include water tanks with capacities up to 20,000 gallons, truck bed liners, playground equipment, air ducts, Nylon fuel tanks, pipes, toys, stretchers, kayaks, pallets, and many others. Thermotropic liquid crystalline polymers are an important class of engineering resins employed in a wide variety of applications. Thermotropic liquid crystalline polymers resins are composed of semi-rigid, nearly linear polymeric chains resulting in an ordered mesomorphic phase between the crystalline solid and the isotropic liquid. Ordering of the rigid rod-like polymers in the melt phase yields microfibrous, self-reinforcing polymer structures with outstanding mechanical and thermal properties. Rotational molding of liquid crystalline polymer resins results in high strength and high temperature hollow structures useful in a variety of applications. Various fillers and reinforcements can potentially be added to improve properties of the hollow structures. This paper focuses on the process and properties of rotationally molded liquid crystalline polymers.
Derived from text
Forming Techniques; Polymers; Synthetic Resins; Mechanical Properties; Thermodynamic Properties

20030065985 NASA Langley Research Center, Hampton, VA, USA

Calculation of Non-Bonded Forces Due to Sliding of Bundled Carbon Nanotubes

Frankland, S. J. V.; Bandorawalla, T.; Gates, T. S.; [2003]; 12 pp.; In English; 44th AIAA/ASME/ASCE/AHS/ASC Structure, Structural Dynamics and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA

Contract(s)/Grant(s): NAS1-97046

Report No.(s): AIAA Paper 2003-1536; Copyright; Avail: CASI; A03, Hardcopy

An important consideration for load transfer in bundles of single-walled carbon nanotubes is the nonbonded (van der Waals) forces between the nanotubes and their effect on axial sliding of the nanotubes relative to each other. In this research, the non-bonded forces in a bundle of seven hexagonally packed (10,10) single-walled carbon nanotubes are represented as an axial force applied to the central nanotube. A simple model, based on momentum balance, is developed to describe the velocity response of the central nanotube to the applied force. The model is verified by comparing its velocity predictions with molecular dynamics simulations that were performed on the bundle with different force histories applied to the central nanotube. The model was found to quantitatively predict the nanotube velocities obtained from the molecular dynamics simulations. Both the model and the simulations predict a threshold force at which the nanotube releases from the bundle. This force converts to a shear yield strength of 10.5-11.0 MPa for (10,10) nanotubes in a bundle.

Author

Carbon Nanotubes; Van Der Waals Forces; Sliding

20030066011 NASA Glenn Research Center, Cleveland, OH, USA

Tantalum Addition to Zirconium Diboride for Improved Oxidation Resistance

Levine, Stanley R.; Opila, Eliizabeth J.; July 2003; 18 pp.; In English; 27th Annual Conference on Composites, Materials and Structures, 27-31 Jan. 2003, Cape Canaveral, FL, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 22-706-85-08

Report No.(s): NASA/TM-2003-212483; E-14025; NAS 1.15:212483; Copyright; Avail: CASI; A03, Hardcopy

Ultrahigh temperature ceramics have performed unreliably due to material flaws and attachment design. These deficiencies are brought to the fore by the low fracture toughness and thermal shock resistance of UHTCs. If these deficiencies are overcome, we are still faced with poor oxidation resistance as a limitation on UHTC applicability to reusable launch vehicles. We have been addressing the deficiencies of UHTCs with our focus on composite constructions and functional grading to address the mechanical issues, and on composition modification to address the oxidation issue. The approaches and progress toward the latter are reported.

Author

Ceramics; Refractory Materials; Tantalum; Zirconium; Borides; Oxidation Resistance; Mechanical Properties

20030066191 NASA Langley Research Center, Hampton, VA, USA

Characterization of Viscoelastic Properties of Polymeric Materials Through Nanoindentation

Odegard, G. M.; Bandorawalla, T.; Herring, H. M.; Gates, T. S.; [2003]; 7 pp.; In English; 2003 SEM Annual Conference and Exposition on Experimental and Applied Mechanics, 2-4 Jun. 2003, Charlotte, NC, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

Nanoindentation is used to determine the dynamic viscoelastic properties of six polymer materials. It is shown that varying the harmonic frequency of the nanoindentation does not have any significant effect on the measured storage and loss moduli of the polymers. Agreement is found between these results and data from DMA testing of the same materials. Varying the harmonic amplitude of the nanoindentation does not have a significant effect on the measured properties of the high performance resins, however, the storage modulus of the polyethylene decreases as the harmonic amplitude increases. Measured storage and loss moduli are also shown to depend on the density of the polyethylene.

Author

Nanoindentation; Viscoelasticity; Polymers; Polymer Physics

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PROPELLANTS AND FUELS

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

20030065860 ATK-Thiokol Propulsion, Brigham City, UT, USA
Correlation of Fuel Regression Rate to O/F Ratio and Mass Flux in 11‘ GOX Hybrid using 18% Aluminized HTPB
Mustaikis, Steve; [2003]; 4 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2003-4594; Copyright; Avail: Other Sources

Significant effort has been expended to predict fuel regression rate in hybrid rocket motors. The simplest method is to base the fuel regression rate on oxidizer flux (r=aG(sub o)(sup n)). This results in a single fuel regression rate for the entire motor, which only occasionally matches empirical data. Some have tried to adjust the fuel regression rate equation by adding a length term to the standard fuel regression rate equation (r=aG(sub o)(sup x)L(sup m)). This works well for a particular motor but cannot be scaled to larger or smaller sizes and does not correlate well for varying motor conditions such as throttling. A promising way to determine the fuel regression rate is through a heat transfer method, where local heat flux is calculated and ablation is predicted based on heat transfer into the fuel. This method, although potentially accurate, requires a well characterized fuel and motor environment which is not always available. A method has been developed to predict regression rate variations vs. length based on local oxidizer/fuel (O/F) ratio of the fuel grain, and total mass flux. This method correlates well with data from the 11’ GOX Hybrid fired at Marshall Space Flight Center.
Author
Ducted Rocket Engines; Htpb Propellants; Propellant Consumption

20030066115 NASA Marshall Space Flight Center, Huntsville, AL, USA
Earth-to-Orbit Rocket Propulsion
Beaurain, Andre; Souchier, Alain; Moravie, Michel; Sackheim, Robert L.; Cikanek, Harry A., III; March 31, 2003; 15 pp.; In English; International Air and Space Symposium and Exposition: The Next 100 Years, 14-18 Jul. 2003, Dayton, OH, USA; Copyright; Avail: CASI; A03, Hardcopy

The Earth-to-orbit (ETO) phase of access to space is and always will be the first and most critical phase of all space missions. This first phase of all space missions has unique characteristics that have driven space launcher propulsion requirements for more than half a century. For example, the need to overcome the force of the Earth s gravity in combination with high levels of atmospheric drag to achieve the initial orbital velocity; i.e., Earth parking orbit or =9 km/s, will always require high thrust- to-weight (TN) propulsion systems. These are necessary with a T/W ratio greater than one during the ascent phase. The only type of propulsion system that can achieve these high T/W ratios are those that convert thermal energy to kinetic energy. There are only two basic sources of onboard thermal energy: chemical combustion-based systems or nuclear thermal-based systems (fission, fusion, or antimatter). The likelihood of advanced open-cycle, nuclear thermal propulsion being developed for flight readiness or becoming environmentally acceptable during the next century is extremely low. This realization establishes that chemical propulsion for ET0 launchers will be the technology of choice for at least the next century, just as it has been for the last half century of rocket flight into space. The world s space transportation propulsion requirements have evolved through several phases over the history of the space program, as has been necessitated by missions and systems development, technological capabilities available, and the growth and evolution of the utilization of space for economic, security, and science benefit. Current projections for the continuing evolution of requirements and concepts may show how future space transportation system needs could be addressed. The evolution and projections will be described in detail in this manuscript.
Author
Earth Orbits; Reusable Rocket Engines; Reusable Spacecraft; Reusable Launch Vehicles

20030066165 ATK-Thiokol Propulsion, Brigham City, UT, USA
Erosive Burning Study Utilizing Ultrasonic Measurement Techniques
Furfaro, James A.; [2003]; 12 pp.; In English; AIAA 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2003-4806; Copyright; Avail: CASI; A03, Hardcopy

A 6-segment subscale motor was developed to generate a range of internal environments from which multiple propellants could be characterized for erosive burning. The motor test bed was designed to provide a high Mach number, high mass flux environment. Propellant regression rates were monitored for each segment utilizing ultrasonic measurement techniques. These data were obtained for three propellants RSRM, ETM- 03, and Castor@ IVA, which span two propellant types, PBAN (polybutadiene acrylonitrile) and HTPB (hydroxyl terminated polybutadiene). The characterization of these propellants indicates a remarkably similar erosive burning response to the induced flow environment. Propellant burnrates for each type had a conventional response with respect to pressure up to a bulk flow velocity threshold. Each propellant, however, had a unique threshold at which it would experience an increase in observed propellant burn rate. Above the observed threshold each propellant again demonstrated a similar enhanced burn rate response corresponding to the local flow environment.
Author (revised)
Htpb Propellants; Erosive Burning; Acrylonitriles; Polybutadiene; Propellants

20030066220 ATK-Thiokol Propulsion, Brigham City, UT, USA
Exhaust Plume IR Measurements for Several Aluminized Propellant Motors
Kent, Randall W.; Tanner, Rick L.; [2003]; 10 pp.; In English; JANNAF Exhaust Plume Technology Subcommitte Meeting, 6-8 May 2003, Bay Saint Louis, MS, USA
Contract(s)/Grant(s): NAS8-97328; Copyright; Avail: Other Sources

The exhaust plume infrared (IR) emission, from three distinct size solid rocket motors, has been measured. Each of these motors utilized the same aluminized propellant formulation, which is used in the current Space Shuttle Reusable Solid Rocket Motor (RSRM). The first motor is RSRM, which is the largest motor in production and it contains approximately 1.1 million pounds of propellant. A second motor is a subscale motor used in the RSRM program and is called the MNASA motor. This motor contains approximately 10,200 pounds of propellant. The third motor is an ATK Thiokol Propulsion standard 5-inch center-perforated (CP) motor. As the name indicates, this motor is five inches in diameter and it contains approximately 7.3 pounds of propellant. Plume measurements from multiple static test motors were made and all of the motor performance parameters will be reported. These motor measurements, when taken together, illustrate the plume spectral characteristics produced by a highly aluminized propellant. In addition, they also show how motor size affects the spectral radiant intensity for an aluminized propellant motor. What is unique about these measurements is that they clearly show the transition of optically thick plumes, which are dominated by particle emission, to optically thin plumes, which are dominated by gaseous emission.
Author
Rocket Exhaust; Infrared Radiation; Metal Propellants; Propellant Additives; Solid Propellant Rocket Engines; Aluminum

31
ENGINEERING (GENERAL)

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

20030065920 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Control of Torsional Vibrations by Pendulum Masses
Stieglitz, Albert; Jahrbuch 1938 der Deutschen Luftfahrtforschung; November 1942, pp. 164-178; In English
Report No.(s): NACA-TM-1035; No Copyright; Avail: CASI; A03, Hardcopy

Various versions of pendulum masses have been developed abroad within the past few years by means of which resonant vibrations of rotating shafts can be eliminated at a given tuning. They are already successfully employed on radial engines in the form of pendulous counterweights. Compared with the commonly known torsional vibration dampers, the pendulum masses have the advantage of being structurally very simple, requiring no internal damping and being capable of completely eliminating certain vibrations. Unexplained, so far, remains the problem of behavior of pendulum masses in other critical zones to which they are not tuned, their dynamic behavior at some tuning other than in resonance, and their effect within a compound vibration system and at simultaneous application of several differently tuned pendulous masses. These problems are analyzed in the present report. The results constitute an enlargement of the scope of application of pendulum masses, especially for in-line engines. Among other things it is found that the natural frequency of a system can be raised by means of a correspondingly tuned pendulum mass. The formulas necessary for the design of any practical version are developed, and

a pendulum mass having two different natural frequencies simultaneously is described.
Author
Rotating Shafts; Torsional Vibration; Resonant Frequencies

20030066112 NASA Marshall Space Flight Center, Huntsville, AL, USA
Multi-Disciplinary Analysis for Future Launch Systems Using NASA's Advanced Engineering Environment (AEE)
Monell, Donald; Mathias, Donovan; Reuther, James; Garn, Michelle; [2003]; 18 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3428; No Copyright; Avail: CASI; A03, Hardcopy

A new engineering environment constructed for the purposes of analyzing and designing Reusable Launch Vehicles (RLVs) is presented. The new environment has been developed to allow NASA to perform independent analysis and design of emerging RLV architectures and technologies. The new Advanced Engineering Environment (AEE) is both collaborative and distributed. It facilitates integration of the analyses by both vehicle performance disciplines and life-cycle disciplines. Current performance disciplines supported include: weights and sizing, aerodynamics, trajectories, propulsion, structural loads, and CAD-based geometries. Current life-cycle disciplines supported include: DDT&E cost, production costs, operations costs, flight rates, safety and reliability, and system economics. Involving six NASA centers (ARC, LaRC, MSFC, KSC, GRC and JSC), AEE has been tailored to serve as a web-accessed agency-wide source for all of NASA's future launch vehicle systems engineering functions. Thus, it is configured to facilitate (a) data management, (b) automated tool/process integration and execution, and (c) data visualization and presentation. The core components of the integrated framework are a customized PTC Windchill product data management server, a set of RLV analysis and design tools integrated using Phoenix Integration's Model Center, and an XML-based data capture and transfer protocol. The AEE system has seen production use during the Initial Architecture and Technology Review for the NASA 2nd Generation RLV program, and it continues to undergo development and enhancements in support of its current main customer, the NASA Next Generation Launch Technology (NGLT) program.
Author
Reusable Launch Vehicles; Design Analysis; Systems Engineering; Systems Analysis

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*.

20030065600 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Multicast Routing Algorithms and Failure Analyses for Low Earth Orbit Satellite Communication Networks
Lee, Jae S.; Aug. 2002; 125 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412964; AFIT/GE/ENG/02-34; No Copyright; Avail: CASI; A06, Hardcopy

In the rapidly changing environment of mobile communications, the importance of the mobile satellite (e,g,, low earth orbit satellites (LEOsats)) networks will increase due to their global visibility and connection. Multicasting is an effective communication method in terms of frequency spectrum usage for a LEO network. It is devised to provide lower network traffic (i,e,, one-to-many transmissions). This research examines the system performance of two dissimilar terrestrially-based multicasting protocols: the Distance Vector Multicast Routing Protocol (DVMRP) and the On Demand Multicast Routing Protocol (ODMRP). These two protocols are simulated in large group membership density and in the presence of satellite failures. Two different algorithms are developed and used to select critical satellites for degrading a LEO network constellation. The simulation results show that the ODMRP protocol successfully reconfigured routes in large group membership density areas and in satellite failure conditions. Results also show that the ODMRP provided reliable packet delivery. However, ODMRP showed an enormous end-to-end delay in severe satellite failure conditions. This result is attributable to the delayed route refreshing procedure of ODMRP. In contrast, the DVMRP suffered from broken routes and complexity in the large group membership density and in satellite failure conditions. It had a smaller packet delivery ratio than the ODMRP (approximately 85,5% versus 98,9% for the 80 user case). The DVMRP showed scalable and stable end-to-end

delay under multiple failed satellite conditions. The large group membership density and the multiple satellite failure conditions provide a more complete assessment for these two protocols.
DTIC
Artificial Satellites; Satellite Communication; Satellite Networks; Failure Analysis; Frequency Distribution

20030066070 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Lightweight, High-Power Radar with Distributed Signal Processing and Thermal Management
Lux, J. P.; Perez, R. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 47; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The proposed system is a novel approach to high performance spacecraft radars. It is a 150 sq m electronically scanned phased array with distributed amplifiers and signal processing, composed of hundreds or thousands of independent elements fabricated on a lightweight deployable substrate. Each element consists of an antenna, RF and digital circuitry, directly attached to the supporting membrane using Chip Scale Packaging (CSP). A primary design feature is that the elements only require DC power connections. The beam steering commands, the RF signals, and array calibration are all done with wireless links. The distributed architecture uses the antenna element as a thermal radiator, making effective utilization of the large DC power available in the JIMO spacecraft. The architecture is applicable to operation from 50 MHz to 20 GHz with 10% BW with selectable bands. This greatly reduces the mechanical design requirements, particularly for higher frequency operation. The elements in the proposed architecture consist of an integrated antenna/thermal radiator, frequency/phase translation, local reference oscillator, wireless link transceiver, and a micro-controller. The only physical electrical connection is for DC power. A smaller number of calibration nodes placed throughout the array are used measure and correct for electrical and physical element positions. This greatly reduces the mechanical design requirements, particularly for higher frequency operation. Wireless links are used for video waveform and control/telemetry between one or more control nodes and the array elements. The elements are essentially smart transponders, using real-time metrology to compensate for the inevitable production and aging performance variations. Salient features: The proposed architecture has the following key technical features: Lightweight scalable construction using chip on deployable substrate (< 1 kg/sq m, estimated); Architecture supports designs for operating frequencies in range from 50 MHz - 20 GHz with 10% bandwidth with multiband operation possible in some cases; 150 sq m aperture thermally supports 40 kW average DC input power; Antenna radiating element used for thermal radiator; 10 kW average RF radiated power, architecture supports duty cycles from continuous to very short pulses with > 100 kW peak power; Distributed processing both of RF and digital information/signals; Wireless distribution of signals, phase refer- ence, control and telemetry; Large number of elements (number of elements depends on operating frequency); Inherent redundancy and gracefir1 degradation; Low Voltage DC power is the only required interconnection; Adaptive calibration for wavefront correction and beamforming; Capability to null interfering signals.
Author
Radar Equipment; Distributed Processing; Signal Processing; Temperature Control

20030066097 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
High Power mm-Wave Transmitter System for Radar or Telecommunications
Stride, S. L.; McMaster, R. L.; Pogorzelski, R. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 84; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Future NASA deep space missions able to provide tens of kilo-watts of spacecraft DC power, make it feasible to employ high power RF telecommunications systems. Traditional flight systems (e.g., Cassini), constrained by limited DC power, used a single high-gain 4m Cassegrain reflector fed by a single lower power (20W) transmitter. Increased available DC power means that high power (1000 W) transmitters can be used. Rather than continue building traditional single-transmitter systems it now becomes feasible to engineer and build multi-element active arrays that can illuminate a dish. Illuminating a 2m dish with a spherical wavefront from an offset 1kW active array can provide sufficient ERP (Effective Radiated Power) when compared to a larger Cassegrain dish. Such a system has the advantage of lower mass, lower volume, improved reliability, less stringent pointing requirements, lower cost and risk. We propose to design and build a prototype Ka-band transmit antenna with an active sub-array using 125W TWTAs. The system could be applied to a telecommunications downlink or radar transmitter used for missions such as JIMO.
Derived from text
Antenna Arrays; Signal Transmission; Radar Transmitters; Satellite Communication; Structural Design

20030066147 NASA Glenn Research Center, Cleveland, OH, USA

A Comparison of MOCLD With PLD Ba(x)Sr(1-x)TiO3 Thin Films on LaAlO3 for Tunable Microwave Applications

VanKeuls, F. W.; Mueller, C. H.; Romanofsky, R. R.; Warner, J. D.; Miranda, F. A.; Jiang, H.; August 2003; 13 pp.; In English

Contract(s)/Grant(s): WBS 755-08-0B

Report No.(s): NASA/TM-2002-210906/REV1; E-12783-1/REV1; NAS 1.15:210906/REV1; Copyright; Avail: CASI; A03, Hardcopy

Historically, tunable dielectric devices using thin crystalline Ba(x)Sr(1-x),TiO3 (BST) films deposited on lattice-matched substrates, such as LaAlO3 have generally been grown using pulsed laser deposition (PLD). Highly oriented BST films can be grown by PLD but large projects are hampered by constraints of deposition area, deposition time and expense. The Metal-Organic Chemical Liquid Deposition (MOCLD) process allows for larger areas, faster turnover and lower cost. Several BST films deposited on LaAlO, by MOCLD have been tested in 16 GHz coupled microstrip phase shifters. They can be compared with many PLD BST films tested in the same circuit design. The MOCLD phase shifter performance of 293 degree phase shift with 53 V/micron dc bias and a figure of merit of 47 degree/dB is comparable to the most highly oriented PLD BST films. The PLD BST films used here have measured XRD full-width-at-half-maxima (FWHM) as low as 0.047 degrees. The best FWHM of these MOCLD BST films has been measured to be 0.058 degrees.

Author

Thin Films; Microwaves; Pulsed Laser Deposition; Tunable Filters; Metalorganic Chemical Vapor Deposition; Barium Compounds; Strontium Compounds; Titanium Oxides

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ELECTRONICS AND ELECTRICAL ENGINEERING

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

20030065651 NASA Marshall Space Flight Center, Huntsville, AL, USA

Field Programmable Gate Array for Implementation of Redundant Advanced Digital Feedback Control

King, K. D.; June 2003; 19 pp.; In English

Report No.(s): NASA/TM-2003-212501; NAS 1.15:212501; M-1076; No Copyright; Avail: CASI; A03, Hardcopy

The goal of this effort was to develop a digital motor controller using field programmable gate arrays (FPGAs). This is a more rugged approach than a conventional microprocessor digital controller. FPGAs typically have higher radiation (rad) tolerance than both the microprocessor and memory required for a conventional digital controller. Furthermore, FPGAs can typically operate at higher speeds. (While speed is usually not an issue for motor controllers, it can be for other system controllers.) Other than motor power, only a 3.3-V digital power supply was used in the controller; no analog bias supplies were used. Since most of the circuit was implemented in the FPGA, no additional parts were needed other than the power transistors to drive the motor. The benefits that FPGAs provide over conventional designs-lower power and fewer parts-allow for smaller packaging and reduced weight and cost.

Author

Digital Systems; Feedback Control; Field-Programmable Gate Arrays; Controllers; Redundancy

20030065674 Technical Univ. of Budapest, Hungary

High Capacity Hybrid Fiber-Optic/Wireless Communications System

Berceli, Tibor; Frigyes, Istvan; Banky, Tamas; Csornyei, Mark; Kovacs, Attila; Dec. 2002; 19 pp.; In English

Contract(s)/Grant(s): N00014-01-1-0680

Report No.(s): AD-A411406; No Copyright; Avail: CASI; A03, Hardcopy

The microchip laser is a good candidate for producing a low noise optical beam. As the microchip laser works with locked modes, it is suitable for the optical generation of microwave or millimeter wave signals. However, the frequency difference between the two modes is not stable enough and therefore the generated signal will be unstable as well. We developed a new approach for the stabilization of the relative frequency difference between the modes. For that purpose a high stability millimeter wave oscillator was designed and constructed utilizing dielectric disc resonators. The signal of the stable oscillator was injected into the laser resonator providing this way a stable difference frequency for the optical generation of microwave signals. However, there is another problem because the microchip laser has a noise peak in the transmission band. We developed a new method to suppress that noise peak. The new method was verified by both simulations and measurements.

An experimental set-up was also built. It contained a high-power diode laser pumping a mode locked crystal laser. The frequency difference between the modes was around 20 GHz. After fiber transmission a 20 GHz signal was generated at the reception side by detecting the optical signal having two modes. About 15 dB noise suppression was achieved in the experiments. New modulation methods were theoretically investigated to reduce the bandwidth requirement in combined optical-wireless systems. First of all, the 16 QAM modulation of a subcarrier proved to be a proper new approach.
DTIC
Fiber Optics; Chips (Electronics); Wireless Communication; Telecommunication

20030065788 Ohio State Univ., Columbus, OH
Enhancement of Capabilities of Smart Electromagnetic Structures (SEMS)
Washington, Gregory; Jan. 21, 2002; 7 pp.; In English
Report No.(s): AD-A413757; ARO-37394.1-EG; No Copyright; Avail: CASI; A02, Hardcopy

New smart conformal antenna concepts where passive and electrically active materials are integrated to generate multifunction, adaptive and compact conformal arrays are being considered and developed. Besides, advanced electromagnetic field simulation tools for the design and analysis of conformal active integrated arrays are developed. In addition, novel phased array concepts are being examined.
DTIC
Electromagnetic Fields; Smart Structures; Antennas; Antenna Arrays

20030065885 ATK-Thiokol Propulsion, Brigham City, UT, USA
A Novel Data System for Verification of Internal Parameters of Motor Design
Smith, Doug; Saint Jean, Paul; Everton, Randy; Uresk, Bonnie; [2003]; 8 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-97238; Copyright; Avail: CASI; A02, Hardcopy

Three major obstacles have limited the amount of information that can be obtained from inside an operating solid rocket motor. The first is a safety issue due to the presence of live propellant interacting with classical, electrical instrumentation. The second is a pressure vessel feed through risk arising from bringing a large number of wires through the rocket motor wall safely. The third is an attachment/protection issue associated with connecting gages to live propellant. Thiokol has developed a highly miniaturized, networked, electrically isolated data system that has safely delivered information from classical, electrical instrumentation (even on the burning propellant surface) to the outside world. This system requires only four wires to deliver 80 channels of data at 2300 samples/second/channel. The feed through leak path risk is massively reduced from the current situation where each gage requires at least three pressure vessel wire penetrations. The external electrical isolation of the system is better than that of the propellant itself. This paper describes the new system.
Author
Solid Propellant Rocket Engines; Fiber Optics; Data Acquisition

20030065928 NASA Marshall Space Flight Center, Huntsville, AL, USA
Hardware Evolution of Control Electronics
Gwaltney, David; Steincamp, Jim; Corder, Eric; King, Ken; Ferguson, M. I.; Dutton, Ken; [2003]; 1 pp.; In English; 2003 NASA/DoD Conference on Evolvable Hardware, 9-11 Jul. 2003, Chicago, IL, USA; Copyright; Avail: CASI; A01, Hardcopy

The evolution of closed-loop motor speed controllers implemented on the JPL FPTA2 is presented. The response of evolved controller to sinusoidal commands, controller reconfiguration for fault tolerance,and hardware evolution are described.
CASI
Electronic Control; Motors; Fault Tolerance

20030065971 NASA Ames Research Center, Moffett Field, CA, USA, Computer Sciences Corp., USA
Interplay of Collective Excitations in Quantum Well Intersubband Resonances
Li, Jian-Zhong; Ning, C. Z.; [2003]; 4 pp.; In English
Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D; No Copyright; Avail: CASI; A01, Hardcopy

Intersubband resonances in a semiconductor quantum well (QW) display some of the most fascinating features involving various collective excitations such as Fermi-edge singularity (FES) and intersubband plasmon (ISP). Using a density matrix approach, we treated many-body effects such as depolarization, vertex correction, and self-energy consistently for a

two-subband system. We found a systematic change in resonance spectra from FES-dominated to ISP-dominated features, as QW- width or electron density is varied. Such an interplay between FES and ISP significantly changes both line shape and peak position of the absorption spectrum. In particular, we found that a cancellation of FES and ISP undresses the resonant responses and recovers the single-particle features of absorption for semiconductors with a strong nonparabolicity such as InAs, leading to a dramatic broadening of the absorption spectrum.
Author
Resonance; Semiconductors (Materials); Quantum Wells; Plasmons

20030065973 NASA Marshall Space Flight Center, Huntsville, AL, USA
Intrinsic Hardware Evolution for the Design and Reconfiguration of Analog Speed Controllers for a DC Motor
Gwaltney, David A.; Ferguson, Michael I.; [2003]; 38 pp.; In English; 2003 NASA/DoD Conference on Evolvable Hardware, 9-11 Jul. 2003, Chicago, IL, USA; No Copyright; Avail: CASI; A03, Hardcopy

Evolvable hardware provides the capability to evolve analog circuits to produce amplifier and filter functions. Conventional analog controller designs employ these same functions. Analog controllers for the control of the shaft speed of a DC motor are evolved on an evolvable hardware platform utilizing a second generation Field Programmable Transistor Array (FPTA2). The performance of an evolved controller is compared to that of a conventional proportional-integral (PI) controller. It is shown that hardware evolution is able to create a compact design that provides good performance, while using considerably less functional electronic components than the conventional design. Additionally, the use of hardware evolution to provide fault tolerance by reconfiguring the design is explored. Experimental results are presented showing that significant recovery of capability can be made in the face of damaging induced faults.
Author
Evolvable Hardware; Speed Regulators; Electric Motors; Control Systems Design

20030066116 NASA Marshall Space Flight Center, Huntsville, AL, USA, Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Hardware Evolution of Analog Speed Controllers for a DC Motor
Gwaltney, David A.; Ferguson, Michael I.; [2003]; 26 pp.; In English; 2003 Genetic and Evolutionary Computation Conference, 12-16 Jul. 2003, Chicago, IL, USA; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides information on the design of analog speed controllers for DC motors on aerospace systems. The presentation includes an overview of controller evolution, evolvable controller configuration, an emphasis on proportion integral (PI) controllers, schematic diagrams, and experimental results.
CASI
Speed Regulators; Control Systems Design; Electric Motors; Evolvable Hardware

20030066170 Naval Research Lab., Washington, DC
InAs Device Process Development and Characterization
Ikossi, Kiki; May 19, 2003; 46 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413747; NRL/FR/6853-03-10; 026; No Copyright; Avail: CASI; A03, Hardcopy

This report summarizes the results of the initial effort in InAs bipolar device development. InAs is one of the III-V semiconductor materials exhibiting a relatively small energy bandgap and extremely high electron mobility, properties both desirable for high-frequency, low-power dissipation device applications. The major accomplishment of this work is the development of a robust device fabrication process that can be directly transferred to an industrial environment. Ti/Pt/Au was used as a universal n- and p- type contact with record low contact resistances. For the base access etch, which is one of the critical issues for bipolar device processing, a unique doping dependence etch was discovered for InAs that allows the base access etch to stop at the appropriate layer. The low-bandgap InAs and heavy doping resulted in premature breakdown through current tunneling and uncontrollable reverse leakage current. This effect was addressed successfully through interactive MBE growth, device characterization, and material analysis techniques. Pn junctions, the building blocks for bipolar transistors were produced with reverse leakage current as low as 10 micronA at -1 V and breakdown voltages as high as 6.5 V. The InAs pn junctions produced had promising rectifying diode characteristics for low-voltage operation and high-speed current amplifier applications.
DTIC
Indium Arsenides; Semiconductors (Materials); Molecular Beam Epitaxy; Bipolar Transistors

20030066178 California Univ., Santa Barbara, CA
Ultra High Speed Heterojunction Bipolar Transistor Technology
Rodwell, Mark; Urtega, M.; Scott, D.; Dahlstrom, M.; Betser, Y.; Jan. 2000; 4 pp.; In English
Report No.(s): AD-A413790; ARO-37242.21-EL-MUR; No Copyright; Avail: CASI; A01, Hardcopy

Scaling of HBTs for high circuit bandwidth and high current gain (f (sub tau)) and power gain (f max) cutoff frequencies is summarized. Key bandwidth limits include scaling of the collector-base junction, the emitter Ohmic contact resistivity and greatly increased current density. Substrate transfer processes allow submicron collector sealing, and have produced HBTs with 20 dB power gain at 100 GHz. 295 GHz f (sub tau) has been obtained. Key to continued progress is improvement of emitter contacts and reliable operation at approximately 10 to the 6th power Amperes/cm2 current density.
DTIC
Electrical Resistivity; Heterojunctions; Bipolar Transistors; Emitters

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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*.

20030065615 New Mexico State Univ., Las Cruces, NM
Quasi-Wavelet Models for Atmospheric Turbulence
Goedecke, George H.; Wilson, D. K.; Ostashev, Vladimir E.; Auvermann, Harry J.; Jan. 2002; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0640
Report No.(s): AD-A413962; No Copyright; Avail: CASI; A01, Hardcopy

Turbulence is generally conceived as a collection of eddies of many different sizes (Hinze, 1975; Batchelor, 1953). The 'quasi-wavelet' (QW) model discussed in this paper is an attempt to develop a mathematical representation for the turbulence that more closely resembles this physical picture than Fourier modes or customary wavelets. Like customary wavelets(Farge 1992; Meneveau 1994) the QW representation is based on self-similar localized functions. However the orientations and positions of the quasi-wavelets are random and the QW basis functions are not required to be orthonormal or to form a mathematically complete set. Some other important features of quasi-wavelets are: *They naturally have ensemble statistics close to that of real turbulence as a consequence of the realistic basis functions. *They can simultaneously provide information about scales of motion and spatial intermittency. *They potentially allow simplified models of anisotropy and inhomogeneity. *They can readily be used to generate synthetic turbulence fields.
DTIC
Wavelet Analysis; Atmospheric Turbulence; Mathematical Models; Inhomogeneity

20030065648 NASA Langley Research Center, Hampton, VA, USA
Three-Dimensional Turbulent RANS Adjoint-Based Error Correction
Park, Michael A.; [2003]; 14 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-3849; No Copyright; Avail: CASI; A03, Hardcopy

Engineering problems commonly require functional outputs of computational fluid dynamics (CFD) simulations with specified accuracy. These simulations are performed with limited computational resources. Computable error estimates offer the possibility of quantifying accuracy on a given mesh and predicting a fine grid functional on a coarser mesh. Such an estimate can be computed by solving the flow equations and the associated adjoint problem for the functional of interest. An adjoint-based error correction procedure is demonstrated for transonic inviscid and subsonic laminar and turbulent flow. A mesh adaptation procedure is formulated to target uncertainty in the corrected functional and terminate when error remaining in the calculation is less than a user-specified error tolerance. This adaptation scheme is shown to yield anisotropic meshes with corrected functionals that are more accurate for a given number of grid points then isotropic adapted and uniformly refined grids.
Author
Computational Grids; Error Analysis; Grid Refinement (Mathematics); Mathematical Models; Flow Equations; Computational Fluid Dynamics; Three Dimensional Models; Correction

20030065789 Naval Research Lab., Washington, DC
Advanced Radiation Theory Support Annual Report 2002
Davis, J.; Apruzese, J.; Chong, Y.; Clark, R.; Dasgupta, A.; May 2003; 150 pp.; In English
Report No.(s): AD-A413953; NRL/MR/6720--03-8660; No Copyright; Avail: CASI; A07, Hardcopy

This report describes the work of the Radiation Hydrodynamics Branch during FY 2002 in support of the DTRA PRS Program Critical issues covered are: (1) side-on and end-on x-ray imaging of wire and gas puff implosions, (2) multi-group radiative diffusion, (3) discussions of radiation transport that includes pitfalls inherent to radiation modeling of Z-pinch plasmas, (4) K-shell yield performance assessment of argon loads on DTRA machines, (5) Z-pinch-driven direct drive inertial confinement fusion, (6) Z-scaled K-shell dielectronic recombination rate coefficients, (7) modeling enhanced energy coupling in Z-pinch plasmas, (8) incompressible fluid model for wire array implosions, and (9) increasing K-shell yields by using a low-z gas in the outer shell of a double-puff nozzle.
DTIC
Radiation; Hydrodynamics; Implosions

20030065802 National Advisory Committee for Aeronautics, Washington, DC, USA
Elliptic Functions and Integrals with Real Modulus in Fluid Mechanics
Legendre, Robert; Les Fonctions et Integrales Elliptiques a Module Reel en Mecanique des Fluids; June 1958; 114 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-TM-1435; No Copyright; Avail: CASI; A06, Hardcopy

Advantage of the elliptic functions and of the more general functions of Schwarz for fluid mechanics. Flows outside and inside polygons. Application to the calculation of an elbow diffuser for a wind tunnel. Properties of the elliptic integrals of the first kind and of the elliptic functions. Properties of the theta functions and decomposition of the elliptic functions into products of theta functions. Properties of the zeta functions. Decomposition of the elliptic functions into sums of zeta functions and calculations of the elliptic integrals. Applications to the calculation of wing profiles, of compressor profiles, and to the study of the vibrations of airplane wings and of compressor vanes. The manuscript of the present paper was checked by Mr. Eichelbrenner who corrected several imperfections and suggested numerous improvements to make reading of the paper easier. However, the limited subject does not permit filling in more than an incomplete knowledge of the properties of analytic functions.
Author
Elliptic Functions; Integrals; Fluid Mechanics; Analytic Functions

20030065813 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Development of an Experimental Test Section for Forcing Unsteady Flow in a Linear Compressor Cascade using Circular Rods
Wade, Patrick C.; Mar. 2003; 200 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413838; AFIT/DS/ENY/02-4; No Copyright; Avail: CASI; A09, Hardcopy

Upstream propagating waves impinging on a cascade of compressor blades were examined in an effort to better understand the influence of downstream components on high cycle fatigue in turbine engines. An array of cylinders was used to simulate the unsteady field generated by a rotor downstream of a set of stators. The unsteady flow upstream of a single cylinder and an array of cylinders, with and without an upstream cascade, was examined experimentally and computationally. Computational results indicate that the cylinders would only shed coherently when placed downstream of a set of blades. Coherent shedding is created when each of the cylinders in the array shed a vortex at the same instance in time. The computational results were verified experimentally and the required flow conditions for coherent vortex shedding were examined. Coherent vortex shedding was maximized by placing the cylinders in the centerline of the blade passages. The unsteady velocity was measured over a cascade blade with the cylinders located in an array downstream of the blades. Unsteady velocities measured along the blade indicate that he downstream cylinders create upstream propagating velocity fluctuations that are maximum at the trailing edge. The increasing aptitude of the unsteady velocities towards the trailing edge of the blade was seen both experimentally and computationally. Additionally, the computational results show that the unsteady fluctuations in the pressure along the blade surface also increases towards the trailing edge of the blade. The magnitude of the upstream propagating velocity fluctuations was increased with increasing free stream velocity. Unsteady velocities generated by individual cylinders were superposed to recreate the unsteady flow field of the cylinder array and compared favorably with the cylinder array results towards the trailing edge of the blade.
DTIC
Unsteady Flow; Gas Turbines; Compressor Blades; Rotor Dynamics

20030065848 NASA Marshall Space Flight Center, Huntsville, AL, USA
Quasi-One-Dimensional Modeling of Pulse Detonation Rocket Engines
Morris, Christopher I.; [2003]; 9 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-5204; No Copyright; Avail: CASI; A02, Hardcopy

Pulse detonation rocket engines (PDREs) offer potential performance improvements over conventional designs, but represent a challenging modeling task. A quasi 1-D, finite-rate chemistry CFD model for a PDRE & described and implemented. A parametric study of the effect of blowdown pressure ratio on the performance of an optimized, fixed PDRE nozzle configuration is reported. The results are compared to a steady-state rocket system using similar modeling assumptions. Author

Pulse Detonation Engines; Mathematical Models; Computational Fluid Dynamics

20030065919 NASA Marshall Space Flight Center, Huntsville, AL, USA
Pre- and Post-Test Predictions of the Flow in a Multi-Stage Supersonic Turbine
Dorney, Daniel J.; Griffin, Lisa W.; Huber, Frank; Sondak, Douglas L.; [2003]; 22 pp.; In English; 39th AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: Other Sources

The drive towards high-work turbines has led to designs which can be compact, transonic, supersonic, counter rotating, or use a dense drive gas. In a recent study a two-stage supersonic turbine was designed using one-dimensional, two-dimensional and three- dimensional computational analyses, along with optimization techniques. The turbine is currently being tested at NASA Marshall Space Flight Center. This paper compares the pre- and post-test predictions with the experimental data.
Author

Computational Fluid Dynamics; Unsteady Flow; Supersonic Turbines; Design Optimization; Boundary Conditions; Performance Prediction

20030065925 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thermodynamic Venting System (TVS) Modeling and Comparison with Liquid Hydrogen Test Data
Hedayat, A.; Bailey, J. W.; Hastings, L. J.; Flachbart, R. H.; Holt, K. A.; [2003]; 8 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-4450; Copyright; Avail: Other Sources

In support of developing a zero gravity pressure control capability for liquid hydrogen, a series of thermodynamic venting system (TVS) tests was conducted at Marshall Space Flight Center (MSFC) using the multipurpose hydrogen test bed (MHTB) in 1996 and 1998. These tests were performed with two ambient heat leaks for tank fill levels of 90%, 50%, and 25%. TVS performance testing revealed that the spray bar was highly effective in providing tank pressure control within a 7-kPa band (131-138 kPa) and destratification of the liquid and the ullage was achieved with all test conditions. Eight of the MHTB tests were correlated with results from the TVS performance analytical model. The tests were selected to encompass the range of tank fill levels, ambient heat leak, operational modes, and ullage pressurants tested. The TVS model-predicted ullage pressure and temperature as well as the bulk liquid saturation pressure and temperature were compared with the applicable test data. During self-pressurization following tank lockup, the model predicted faster pressure rise rates than were measured. However, once the system entered the cyclic self-pressurizing/mixing/venting operational mode, good agreements were shown between the predicted values and the corresponding test data.
Author

Thermodynamics; Venting; Mathematical Models; Liquid Hydrogen; Leakage; Tanks (Containers)

20030065991 NASA Marshall Space Flight Center, Huntsville, AL, USA
CFD-based Design of LOX Pump Inlet Duct for Reduced Dynamic Loads
Rothermel, Jeffry; Dorney, Daniel J.; Dorney, Suzanne M.; [2003]; 13 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2003-4913; No Copyright; Avail: CASI; A03, Hardcopy

Numerical simulations have been completed for a variety of designs for a 90 deg elbow duct. The objective is to identify a design that minimizes the dynamic load entering a LOX turbopump located at the elbow exit. Designs simulated to date indicate that simpler duct geometries result in lower losses. Benchmark simulations have verified that the compressible flow

code used in this study is applicable to these incompressible flow simulations.
Author
Computational Fluid Dynamics; Liquid Oxygen; Turbine Pumps; Intake Systems; Ducts; Design

20030066105 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Generalized Fluid Formulation for Turbomachinery Computations
Merkle, Charles L.; Sankaran, Venkateswaran; Dorney, Daniel J.; Sondak, Douglas L.; [2003]; 22 pp.; In English; 33rd AIAA Fluid Dynamics Conference and Exhibit, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3999; Copyright; Avail: CASI; A03, Hardcopy

A generalized formulation of the equations of motion of an arbitrary fluid are developed for the purpose of defining a common iterative algorithm for computational procedures. The method makes use of the equations of motion in conservation form with separate pseudo-time derivatives used for defining the numerical flux for a Riemann solver and the convergence algorithm. The partial differential equations are complemented by an thermodynamic and caloric equations of state of a complexity necessary for describing the fluid. Representative solutions with a new code based on this general equation formulation are provided for three turbomachinery problems. The first uses air as a working fluid while the second uses gaseous oxygen in a regime in which real gas effects are of little importance. These nearly perfect gas computations provide a basis for comparing with existing perfect gas code computations. The third case is for the flow of liquid oxygen through a turbine where real gas effects are significant. Vortex shedding predictions with the LOX formulations reduce the discrepancy between perfect gas computations and experiment by approximately an order of magnitude, thereby verifying the real gas formulation as well as providing an effective case where its capabilities are necessary.
Author
Turbomachinery; Ideal Gas; Liquid Oxygen; Algorithms; Equations; Computation

20030066114 NASA Marshall Space Flight Center, Huntsville, AL, USA
Comparison of Experimental Data and Computations Fluid Dynamics Analysis for a Three Dimensional Linear Plug Nozzle
Ruf, J. H.; Hagemann, G.; Immich, H.; [2003]; 17 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A03, Hardcopy

A three dimensional linear plug nozzle of area ratio 12.79 was designed by EADS Space Transportation (former Astrium Space Infrastructure). The nozzle was tested within the German National Technology Program 'LION' in a cold air wind tunnel by TU Dresden. The experimental hardware and test conditions are described. Experimental data was obtained for the nozzle without plug side wall fences at a nozzle pressure ratio of 116 and then with plug side wall fences at NPR 110. Schlieren images were recorded and axial profiles of plug wall static pressures were measured at several spanwise locations and on the plug base. Detailed CFD analysis was performed for these nozzle configurations at NPR 116 by NASA MSFC. The CFD exhibits good agreement with the experimental data. A detailed comparison of the CFD results and the experimental plug wall pressure data are given. Comparisons are made for both the without and with plug side wall fence configurations. Numerical results for density gradient are compared to experimental Schlieren images. Experimental nozzle thrust efficiencies are calculated based on the CFD results. The CFD results are used to illustrate the plug nozzle fluid dynamics. The effect of the plug side wall is emphasized.
Author
Computational Fluid Dynamics; Plug Nozzles; Wind Tunnel Tests

20030066122 NASA Ames Research Center, Moffett Field, CA, USA
High Energy Boundary Conditions for a Cartesian Mesh Euler Solver
Pandya, Shishir; Murman, Scott; Aftosmis, Michael; [2003]; 8 pp.; In English; 42nd AIAA Aerospace Sciences Meeting and Exhibit; No Copyright; Avail: CASI; A02, Hardcopy

Inlets and exhaust nozzles are common place in the world of flight. Yet, many aerodynamic simulation packages do not provide a method of modelling such high energy boundaries in the flow field. For the purposes of aerodynamic simulation, inlets and exhausts are often fared over and it is assumed that the flow differences resulting from this assumption are minimal. While this is an adequate assumption for the prediction of lift, the lack of a plume behind the aircraft creates an evacuated base region thus effecting both drag and pitching moment values. In addition, the flow in the base region is often mis-predicted resulting in incorrect base drag. In order to accurately predict these quantities, a method for specifying inlet and exhaust conditions needs to be available in aerodynamic simulation packages. A method for a first approximation of a plume without

accounting for chemical reactions is added to the Cartesian mesh based aerodynamic simulation package CART3D. The method consists of 3 steps. In the first step, a components approach where each triangle is assigned a component number is used. Here, a method for marking the inlet or exhaust plane triangles as separate components is discussed. In step two, the flow solver is modified to accept a reference state for the components marked inlet or exhaust. In the third step, the flow solver uses these separated components and the reference state to compute the correct flow condition at that triangle. The present method is implemented in the CART3D package which consists of a set of tools for generating a Cartesian volume mesh from a set of component triangulations. The Euler equations are solved on the resulting unstructured Cartesian mesh. The present methods is implemented in this package and its usefulness is demonstrated with two validation cases. A generic missile body is also presented to show the usefulness of the method on a real world geometry.
Author
Boundary Conditions; Cartesian Coordinates; Computerized Simulation; Air Intakes; Exhaust Nozzles

20030066143 NASA Marshall Space Flight Center, Huntsville, AL, USA
Simulations of Flow Through the SSME LH2 Feed Line and LPFP Inducer
Dorney, Daniel J.; Rothermel, Jeffry; [2003]; 17 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

During a post-flight inspection of the liquid hydrogen feed lines leading the Space Shuttle main engines cracks were discover in slots on a flow liner just upstream of the low pressure fuel pump inducer. Numerical simulations have been performed for the feed line, the flow liner (including the slots and backing cavity) and the inducer. The predicted results have been compared with experimental data taken during hot-fire tests at NASA Stennis Space Center.
Author
Liquid Hydrogen; Space Shuttle Main Engine; Computerized Simulation; Computational Fluid Dynamics; Low Pressure; Fuel Pumps; Feed Systems

20030066144 ATK-Thiokol Propulsion, Brigham City, UT, USA
A 3-D CFD Analysis of the Space Shuttle RSRM With Propellant Fins @ 1 sec. Burn-Back
Morstadt, Robert A.; [2003]; 12 pp.; In English; 39th AIAA Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-9723
Report No.(s): AIAA Paper 2003-5105; Copyright; Avail: CASI; A03, Hardcopy

In this study 3-D Computational Fluid Dynamic (CFD) runs have been made for the Space Shuttle RSRM using 2 different grids and 4 different turbulent models, which were the Standard KE, the RNG KE, the Realizable KE, and the Reynolds stress model. The RSRM forward segment consists of 11 fins. By taking advantage of the forward fin symmetry only half of one fin along the axis had to be used in making the grid. This meant that the 3-D model consisted of a pie slice that encompassed 1/22nd of the motor circumference and went along the axis of the entire motor. The 3-D flow patterns in the forward fin region are of particular interest. Close inspection of these flow patterns indicate that 2 counter-rotating axial vortices emerge from each submerged solid propellant fin. Thus, the 3-D CFD analysis allows insight into complicated internal motor flow patterns that are not available from the simpler 2-D axi-symmetric studies. In addition, a comparison is made between the 3-D bore pressure drop and the 2-D axi-symmetric pressure drop.
Author
Computational Fluid Dynamics; Space Shuttles; Three Dimensional Models; Reusable Rocket Engines; Solid Propellants; Fins

20030066152 NASA Ames Research Center, Moffett Field, CA, USA
Automated CFD Database Generation for a 2nd Generation Glide-Back-Booster
Chaderjian, Neal M.; Rogers, Stuart E.; Aftosmis, Michael J.; Pandya, Shishir A.; Ahmad, Jasim U.; Tejmil, Edward; [2003]; 7 pp.; In English; 21st AIAA Applied Aerodynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-3788; No Copyright; Avail: CASI; A02, Hardcopy

A new software tool, AeroDB, is used to compute thousands of Euler and Navier-Stokes solutions for a 2nd generation glide-back booster in one week. The solution process exploits a common job-submission grid environment using 13 computers located at 4 different geographical sites. Process automation and web-based access to the database greatly reduces the user workload, removing much of the tedium and tendency for user input errors. The database consists of forces, moments, and

solution files obtained by varying the Mach number, angle of attack, and sideslip angle. The forces and moments compare well with experimental data. Stability derivatives are also computed using a monotone cubic spline procedure. Flow visualization and three-dimensional surface plots are used to interpret and characterize the nature of computed flow fields.
Author
Computational Fluid Dynamics; Data Bases; Automatic Control; Software Development Tools; Booster Rocket Engines

20030066212 Combustion Research and Flow Technology, Inc., Dublin, PA, USA
A Generalized Multi-Phase Framework for Modeling Cavitation in Cryogenic Fluids
Dorney, Dan, Technical Monitor; Hosangadi, Ashvin; Ahuja, Vineet; June 13, 2003; 14 pp.; In English; 33rd AIAA Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Contract(s)/Grant(s): NAS8-02098
Report No.(s): AIAA Paper 2003-4000; Copyright; Avail: CASI; A03, Hardcopy

A generalized multi-phase formulation for cavitation in fluids operating at temperatures elevated relative to their critical temperatures is presented. The thermal effects and the accompanying property variations due to phase change are modeled rigorously. Thermal equilibrium is assumed and fluid thermodynamic properties are specified along the saturation line using the NIST-12 databank. Fundamental changes in the physical characteristics of the cavity when thermal effects become pronounced are identified; the cavity becomes more porous, the interface less distinct, and has increased entrainment when temperature variations are present. Quantitative estimates of temperature and pressure depressions in both liquid nitrogen and liquid hydrogen were computed and compared with experimental data of Hord for hydrofoils. Excellent estimates of the leading edge temperature and pressure depression were obtained while the comparisons in the cavity closure region were reasonable. Liquid nitrogen cavities were consistently found to be in thermal equilibrium while liquid hydrogen cavities exhibited small, but distinct, non-equilibrium effects.
Author
Cryogenic Fluids; Cavitation Flow; Thermodynamic Properties; Temperature Effects; Thermodynamic Equilibrium; Critical Temperature

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INSTRUMENTATION AND PHOTOGRAPHY

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

20030065669 Call Recall, Inc., San Diego, CA
Multi-Layer Worm Disk with Parallel Recording and Read-Out for High Capacity Storage
Dvornikov, D.; Walker, E.; Rentzepis, P.; Esener, S.; Apr. 2003; 81 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-98-C-0240; Proj-2810
Report No.(s): AD-A413850; AFRL-IF-RS-TR-2003-78; No Copyright; Avail: CASI; A05, Hardcopy

Technology has been developed to enable recording and reading of optical disks having many layers. The approach selected relies on recording bits in a volume by using single beam two-photon recording. A volumetric bit is written in the volume of a molded photochromic dispersed organic polymer only at spatial locations where the recording beam has sufficient photon energy. Data recording is based on two-photon absorption, by which one molecule is excited into a higher state by absorbing the combined energy of two photons. Under this program, the following key sub-system components were developed: (a) Materials with high sensitivity and transparency that can be fabricated into a disk form. (b) Recording and read-out heads that are capable of parallel operation while minimizing interlayer cross-talk. (c) Focus and tracking servo systems that position the heads over the desired data track and layer.
DTIC
Parallel Processing (Computers); Computer Storage Devices

20030065675 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
An Investigation of the Effects of Correlation in Sensor Fusion
Storm, Susan A.; Mar. 2003; 94 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412745; AFIT/GOR/ENS/03-22; No Copyright; Avail: CASI; A05, Hardcopy

This thesis takes the first step towards the creation of a synthetic classifier fusion-testing environment. The effects of data

correlation on three classifier fusion techniques were examined. The three fusion methods tested were the ISOC fusion method (Haspert, 2000), the ROC 'Within' Fusion method (Oxley and Bauer, 2002) and the simple use of a Probabilistic Neural Network (PNN) as a fusion tool. Test situations were developed to allow the examination of various levels of correlation both between and within feature streams. The effects of training a fusion ensemble on a common dataset versus an independent data set were also contrasted. Some incremental improvements to the ISOC procedure were discovered in this process.
DTIC
Classifiers; Data Correlation; Multisensor Fusion; Education

20030065712 Arizona State Univ., Tempe, AZ
Molecular Structure for Smart Materials
May 19, 2001; 5 pp.; In English
Report No.(s): AD-A413993; No Copyright; Avail: CASI; A01, Hardcopy

This project has developed new electron diffraction methods for determining the structure of organic sensors and detectors, including a colorimetric diacetylene phospholipid which changes color when exposed to toxins, and a new hard covalent carbonate. We are concerned with radiation-sensitive molecules which cannot be crystallized for analysis by X-ray crystallography, and with new nanostructured organics which do not form large enough single crystals for X-ray analysis. Since the main problem is radiation damage, we have studied this problem in detail. The use of low electron energies to reduce radiation damage has proven effective. We have obtained the first transmission electron diffraction patterns at a beam energy below the carbon K -shell ionization energy (285 eV). We have designed and constructed a field-emission point-projection electron microscope (PPM), a facility for making coated nanotip field emitters, a low energy electron diffraction camera, and facilities for making thin organic films by the Langmuir Bludgett and other methods. The PPM has successfully given nanometer-resolution coherent electron holograms and reconstructed images, at 200 eV, of Tobacco Mosaic Virus. In addition, we have solved a new organic crystal structure whose sub-micron grain-size prevented it being solved by any other method. This material holds promise as a hard, light, optical material. In summary, we now have the hardware and software in place to image useful organic molecules which do not form large enough crystals for conventional analysis.
DTIC
Molecular Structure; Smart Materials; Diffraction Patterns; Electron Diffraction; Sensors

20030065794 Chicago Univ., Chicago, IL
Improved MR Images of Breast Lesions with Fast Spectroscopic Imaging
Karczmar, Gregory S.; Oct. 2002; 51 pp.; In English
Contract(s)/Grant(s): DAMD17-99-1-9121
Report No.(s): AD-A413852; No Copyright; Avail: CASI; A04, Hardcopy

The goal of this research is to use high spectral and spatial resolution (HiSS) MR imaging to improve images of human breast. Our work on the application of HiSS to improve anatomic and functional imaging was first described in a paper in Academic Radiology. Related work from this laboratory is presented in a number of other publications. Work from other laboratories shows that closely related methods also provide advantages for anatomic and functional MRI. Our funding from the Army has supported implementation of HiSS on clinical scanners and preliminary tests of the method in women with normal breasts and women with breast lesions. The results demonstrate that HiSS provides improved fat-suppression, contrast and edge delineation compared to conventional imaging. The funded work resulted in several publications listed in this report. We are continuing to optimize this method and are applying for additional funding so that it can be tested in a larger group of women.
DTIC
Spectroscopy; Clinical Medicine; Mammary Glands; Cancer; Magnetic Resonance; Imaging Techniques

20030066013 California Inst. of Tech., Pasadena, CA, USA
Dustbuster: A Proposed JIMO Instrument, for Jovian Satellite and Ring Dust Analyzer
Ahrens, T. J.; Beauchamp, J. L.; Austin, D. E.; Willis, M. J.; Shen, A. H.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 1; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The JIMO mission carrying a dust analyzer such as Dustbuster allows chemical analysis of satellite composition through measurements of micrometeorite impact ejecta that are predominantly surface material, the composition of Io's volcanic plumes and the makeup of the Jovian rings. If JIMO deploys a satellite impactor, the mass and altitude distribution of ejecta

as measured by Dustbuster (DB) will place strong constraints on the strength and porosity of satellite surface material, complementing the chemical analysis.
Author
Cosmic Dust; Spacecraft Instruments; Interplanetary Spacecraft; Jupiter Satellites; Chemical Analysis; Mass Spectrometers; Time Of Flight Spectrometers

20030066017 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
A Low Frequency Radio and Radar Instrument to Explore Jupiter's Icy Moons
Kurth, W. S.; Gurnett, D. A.; Plaut, J.; Bolton, S. J.; Farrell, W. M.; Desch, M. D.; Kaiser, M. L.; Zarka, P.; Lecacheux, A.; Bale, S. D., et al.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 42; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The addition of a comprehensive wave investigation to the Jupiter Icy Moons Orbiter (JIMO) science payload will provide a broad range of information on the icy moons of Jupiter including the detection of subsurface liquid oceans; mapping of their ionospheres; their interaction with the magnetospheric environment; and on the Jovian magnetosphere. These measurements are obtained through the use of both passive and active (sounding) means over broad frequency ranges. The frequency range of interest extends from less than 1 Hz to 40 MHz for passive measurements, from approximately 1 kHz to a few MHz for magnetospheric and ionospheric sounding, and between 1 and approximately 10 MHz for subsurface radar sounding. An instrument to detect subsurface radar sounding, magnetospheric interactions, and ionospheric sounding is discussed.
Derived from text
Jupiter Satellites; Low Frequencies; Measuring Instruments; Space Exploration; Radar Measurement; Radio Emission

20030066025 Hokkaido Univ., Sapporo, Japan
Direct Measurements of Heat Flux and Surface Strain on Europa by Penetrater
Arakawa, Masahiko; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 3; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

I propose an apparatus, so called penetrater, which size is about 1 m and the shape is like a bullet, to measure the subsurface heat flux. This apparatus is equipped with thermometers on the surface, and each thermometer is set with the distance more than several 10 cm, the maximum of 1 m. This apparatus is dropped on the surface of icy crust with the velocity of several 100 m and penetrates into the icy crust. The direct contact of the penetrater with the crust enables us to measure the accurate subsurface temperature at different depth. The heat flux can be estimated by using these temperatures and the thermal properties of the crust measured at the same time. The plural penetraters dropped on the surface with each distance of about 1 km can work as the network to measure the surface strain. The accuracy less than 1 mm to determine the position is necessary to detect the surface strain exerted by the tidal force. The tidal force acting on Europa caused by Jupiter is the most important mechanism to generate the heating energy to control Europa tectonics. The tide on Europa repeats every 3.55 days. The tidal heating seems to keep the thick liquid water below the icy crust and the thickness of the ice crust above the sea is closely related to the tidal heating itself and the heat transfer mechanism.
Author
Europa; Planetary Geology; Temperature Measurement; Spacecraft Instruments; Heat Flux; Ice; Penetration

20030066026 Cornell-Sydney Univ. Astronomy Center, Ithaca, NY, USA
Radar and Radiometry of Jupiter's Upper and Middle Troposphere
Banfield, D.; Dissly, R.; Butler, B.; Gierasch, P.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 5; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The JIMO platform, with its specification for > 45 kW of disposable power, is an excellent spacecraft with which to conduct latitudinally resolved passive radiometry and radar of Jupiter's atmosphere. We will present results from an ongoing investigation into the feasibility and potential scientific return of such an investigation as well as its requirements from the JIMO mission. Ground-based radio images of Jupiter show belt/zone differences in brightness temperatures which indicate ammonia abundance differences presumably due to circulation distillation. Similar (and quantitative) results are now also coming out of Cassini CIRS retrievals. These both suggest upwelling in Zones and downwelling in Belts. Massive, convecting upwellings identified in Galileo and Cassini imaging strongly point to water clouds and thunderstorms predominately in Belts. Taken together, these indicators mean that upwelling is occurring deeper down in Belts, while near and above the visible cloud level Belts are regions of downwelling. In our theory of Jupiter's tropospheric circulation, the level at which these overturning cells converge is also the level at which the forcing that drives the zonal jets is centered. Obtaining a better understanding of

these overturning cells, and the location of momentum transfer to the jets is critical for furthering our understanding of Jupiter's circulation and arguably is the next logical step deeper in the atmosphere towards that goal.
Author
Jupiter Atmosphere; Meteorological Radar; Microwave Radiometers; Spacecraft Instruments; Spacecraft Communication; Radio Telemetry

20030066033 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Applications of High Etendue Line-Profile Spectro-Polarimetry to the Study of the Atmospheric and Magnetospheric Environments of the Jovian Icy Moons
Harris, Walter M.; Roesler, Fred L.; Jaffel, Lotfi Ben; Ballester, Gilda E.; Oliversen, Ronald J.; Morgenthaler, Jeffrey P.; Mierkiewicz, Edwin; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 29; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Electrodynamic effects play a significant, global role in the state and energization of the Earth's ionosphere/magnetosphere, but even more so on Jupiter, where the auroral energy input is four orders of magnitude greater than on Earth. The Jovian magnetosphere is distinguished from Earth's by its rapid rotation rate and contributions from satellite atmospheres and internal plasma sources. The electrodynamic effects of these factors have a key role in the state and energization of the ionosphere-corona- plasmasphere system of the planet and its interaction with Io and the icy satellites. Several large scale interacting processes determine conditions near the icy moons beginning with their tenuous atmospheres produced from sputtering, evaporative, and tectonic/volcanic sources, extending out to exospheres that merge with ions and neutrals in the Jovian magnetosphere. This dynamic environment is dependent on a complex network of magnetospheric currents that act on global scales. Field aligned currents connect the satellites and the middle and tail magnetospheric regions to the Jupiter's poles via flux tubes that produce as bright auroral and satellite footprint emissions in the upper atmosphere. This large scale transfer of mass, momentum, and energy (e.g. waves, currents) means that a combination of complementary diagnostics of the plasma, neutral, and and field network must be obtained near simultaneously to correctly interpret the results. This presentation discusses the applicability of UV spatial heterodyne spectroscopy (SHS) to the broad study of this system on scales from satellite surfaces to Jupiter's aurora and corona.
Derived from text
Ultraviolet Spectroscopy; Ultraviolet Spectrometers; Satellite Instruments; Galilean Satellites; Satellite Atmospheres; Planetary Magnetic Fields

20030066037 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Fine Resolution Topographic Mapping of the Jovian Moons: A Ka-Band High Resolution Topographic Mapping Interferometric Synthetic Aperture Radar
Madsen, S. N.; Carsey, F. D.; Turtle, E. P.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 48; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The topographic data set obtained by MOLA has provided an unprecedented level of information about Mars' geologic features. The proposed flight of JIMO provides an opportunity to accomplish a similar mapping of and comparable scientific discovery for the Jovian moons through use of an interferometric imaging radar analogous to the Shuttle radar that recently generated a new topographic map of Earth. A Ka-band single pass across-track synthetic aperture radar (SAR) interferometer can provide very high resolution surface elevation maps. The concept would use two antennas mounted at the ends of a deployable boom (similar to the Shuttle Radar Topographic Mapper) extended orthogonal to the direction of flight. Assuming an orbit altitude of approximately 100km and a ground velocity of approximately 1.5 km/sec, horizontal resolutions at the 10 meter level and vertical resolutions at the sub-meter level are possible.
Derived from text
Synthetic Aperture Radar; Planetary Mapping; Galilean Satellites; Satellite Surfaces; Spacecraft Instruments; Topography

20030066043 University of Central Florida, Orlando, FL, USA
Imaging Spectrometer with High-Responsivity and No Moving Parts
Sellar, R. G.; Kirkland, L. E.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 72; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Technology programs funded by DoD and by NASA (through the PIDDP program) have led to the development of a class of imaging spectrometer that combines the principal advantages of two traditional techniques used for imaging spectrometry: the signalcollection advantage offered by the interferometric or Fourier Transform Spectrometer (FTS) class, and the

no-moving-parts advantage offered by the dispersive and filter-array classes. This new class of imaging spectrometer, referred to as interferometric windowing, has no filters, no slit, and no moving parts. The advantage of having no moving parts provides allows the interferometer to be monolithic (comprised of a single, solid optical element and therefore extremely rugged and relatively inexpensive. The high responsivity of this instrument makes this approach ideal for missions to the outer planets. Derived from text

Imaging Spectrometers; Imaging Techniques; Optical Equipment

20030066050 Imperial Chemical Industries Ltd., London, UK

A Magnetometer Instrument for the JIMO Mission

Dougherty, M. K.; Balogh, A.; Carr, C. M.; Kellock, S.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 20; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

A magnetometer instrument, based on a proposal submitted to the Europa Orbiter Announcement of Opportunity, is described. The primary science aim of the instrument would be to characterize the electromagnetic fields which are induced around Europa, Ganymede and Callisto. These signatures will then be interpreted in light of the internal structure of the moons. The design of the instrument consists of a 3-axis fluxgate sensor mounted on a deployable or stub boom. The magnetometer electronics are remote from the sensor and housed in a spacecraft body mounted electronics box. Functionally the instrument is very similar to the fluxgate sensor already flying on the Cassini mission, but in addition the instrument will be immune to the different and more severe radiation environment. The magnetometer will allow the frequency spectrum of the induced magnetic fields to be probed allowing an investigation of the presence and properties of the electrically conducting material beneath the surface to be carried out. Magnetometer data in combination with radar data will enable a model of the vertical structure of the body to be derived, thereby allowing the interior of the moon to be probed. The existence of liquid water may have implications for the possible existence of life. In addition, the magnetospheric and source/atmosphere interactions in the vicinity of the moons will also be probed.

Derived from text

Magnetometers; Electromagnetic Fields; Magnetic Signatures; Callisto; Ganymede; Europa; Structural Design; Spacecraft Instruments

20030066055 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

High Sensitivity Long-Wavelength Infrared QWIP Focal Plane Array Based Instrument for Remote Sensing of Icy Satellites

Gunapala, S.; Bandara, S.; Ivanov, A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 27; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

GaAs based Quantum Well Infrared Photodetector (QWIP) technology has shown remarkable success in advancing low cost, highly uniform, high-operability, large format multi-color focal plane arrays. QWIPs afford greater flexibility than the usual extrinsically doped semiconductor IR detectors. The wavelength of the peak response and cutoff can be continuously tailored over a range wide enough to enable light detection at any wavelength range between 6 and 20 micron. The spectral band-width of these detectors can be tuned from narrow (Deltalambda/lambda is approximately 10%) to wide (Deltalambda/lambda is approximately 40%) allowing various applications. Furthermore, QWIPs offer low cost per pixel and highly uniform large format focal plane arrays due to mature GaAs/AlGaAs growth and processing technologies. The other advantages of GaAs/AlGaAs based QWIPS are higher yield, lower l/f noise and radiation hardness (1.5 Mrad). In this presentation, we will discuss our recent demonstrations of 640x512 pixel narrow-band, broad-band, multi-band focal plane arrays, and the current status of the development of 1024x1024 pixel long-wavelength infrared QWIP focal plane arrays.

Derived from text

Focal Plane Devices; Infrared Detectors; Semiconductors (Materials); Remote Sensing; Icy Satellites

20030066062 Ball Aerospace and Technologies Corp., Boulder, CO, USA

Pushbroom Sensor Concepts for the JIMO Mission

Kaplan, M. L.; Dissly, R. W.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 35; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

JIMO presents an opportunity to the planetary science community to expand the detailed knowledge (data) of the composition and geomorpology of Jupiter's Icy Moons - Callisto, Ganymede, Europa. This data will be used to develop understanding of the origin and evolution of these bodies as well as determination of life and sustainability potential. This presentation focuses on a class of data collection payloads typically employed in a remote sensing mission that the JIMO space

segment will provide. Described as Push-Broom imaging, this sensor concept is explored for applicability to JIMO. General data will be provided on state-of-the-art sensors currently being developed for the following missions: Mars-HiRISE ('The Peoples Camera'), Pluto-RALPH and National Polar-orbiting Operational Environmental Satellite System (NPOESS - 'Weather-SATs'). Performance of these sensors will be normalized for use on the JIMO mission. For example, the HiRISE payload operating at a 100 km orbit would provide: 12.5 cm/pixel resolution; 2.5 km swath width coverage in 3 distinct panchromatic bands (Blue-Green, Red, NIR); and stereo imaging vertical height resolution of approximately 7.5 cm. Key systems engineering parameters (SNR, Aperture, IFOV, ground speed, LOS pointing, data rate, etc) will be discussed in relation to scientific metrics (Level 1 requirements) and their impact on m&power/data volume. Environmental (e.g. Radiation, Solar illumination, etc.) as well as operational (e.g. LOS pointing control, data volume, etc) requirements and their impacts on these sensor system parameters will be evaluated using trade space examples. Current Ball IRAD efforts to: simplify this class of pay-load (mass/power reduction); as well as expanding the scientific collection capabilities (resolution for both spatial & spectral, sensitivity for low light levels) will be discussed. The intent is to provide the science community a basis for evaluating 'data collection requirements' relative to their impact on the sensor system(s).
Derived from text
Payloads; Data Acquisition; Spacecraft Instruments; Galilean Satellites; Satellite Surfaces; Systems Engineering

20030066067 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
A Secondary Ion Mass Analyzer for Remote Surface Composition Analysis of the Galilean Moons
Krueger, H.; Srama, R.; Johnson, T. V.; Henkel, H.; vonHoerner, H.; Koch, A.; Horanyi, M.; Gruen, E.; Kissel, J.; Krueger, F.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 41; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Galileo in-situ dust measurements have shown that the Galilean moons are surrounded by tenuous dust clouds formed by collisional ejecta from their icy surfaces, kicked up by impacts of interplanetary micrometeoroids. The majority of the ejecta dust particles have been sensed at altitudes below five between 0.5 and 1 micron, just above the detector threshold, indicating a size distribution decreasing towards bigger particles. their parent bodies. They carry information about the properties of the surface from which they have been kicked up. In particular, these grains may carry organic compounds and other chemicals of biological relevance if they exist on the icy Galilean moons. In-situ analysis of the grain composition with a sophisticated dust analyzer instrument flying on a Jupiter Icy Moons Orbiter can provide important information about geochemical and geophysical processes during the evolutionary histories of these moons which are not accessible with other techniques from an orbiter spacecraft. Thus, spacecraft-based in-situ dust measurements can be used as a diagnostic tool for the analysis of the surface composition of the moons. This way, the in-situ measurements turn into a remote sensing technique by using the dust instrument like a telescope for surface investigation. An instrument capable of very high resolution composition analysis of dust particles is the Cometary Secondary Ion Mass Analyzer (COSIMA). The instrument was originally developed for the Comet Rendezvous and Asteroid Flyby (CRAF) mission and has now been built for ESA'S comet orbiter Rosetta. Dust particles are collected on a target and are later located by an optical microscope camera. A pulsed primary indium ion gun partially ionizes the dust grains. The generated secondary ions are accelerated in an electric field and travel through a reflectron-type time-of-flight ion mass spectrometer.
Derived from text
Satellite Instruments; In Situ Measurement; Measuring Instruments; Dust; Galilean Satellites; Satellite Surfaces; Chemical Analysis

20030066069 Arizona Univ., Tucson, AZ, USA
JIMO Propulsion System as an Ion Probe of Satellite Surfaces
Lorenz, R. D.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 46; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Secondary Ion Mass Spectrometry (SIMS) is a well-established laboratory tool for surface analysis. An ion beam is used to sputter materials from the target surface for capture in a conventional mass spectrometer. A free-space version of the technique was flown on the Russian Phobos-2 mission, but was sadly not tested before the mission was lost. Here I advocate as an experiment (with little or no resource requirements) the use of the ion propulsion system on JIMO as a long-distance ion probe. A previous investigation by the author indicated the technique of using an ion thruster as a probe has potential for asteroid surface investigation. As the JIMO factsheet (spacescience.hq.nasa.gov/missions/JIMO.pdf) suggests that (ample) ion propulsion is to be available on this mission, the technique merits application as an experiment at the Galilean satellites, exploiting equipment already on board. An ion beam impinging on a surface in vacuum will sputter ions from the top micron or so of the target surface. These might include species diagnostic of the ices, rock minerals and ice solutes on Galilean

surfaces. Remote laser mass spectrometry can also be used, but would require a separate and powerful laser to deposit energy onto the target surface. Assuming typical parameters (Xenon working fluid, Isp-3000s using an accelerating potential or grid voltage of approx. 1kV) imples about 20 mA of beam current per mN of thrust, or, neglecting thruster inefficiencies, about 20 W/mN. Devoting a not unreasonable 20 kW to thruster power yields a thrust of 20N, and a beam current of 20A, or (for singly- charged ions) about 10(exp 20) ions/sec. (The ion source on the Phobos instrument had a 2mA 3 keV krypton ion source.) Ground tests on ion thrusters suggests that the beam will typically spread out into a cone with a half-angle of 10 degrees. Thus the physical size of the spot illuminated by the beam will directly correspond to distance from the target area - at 100 km altitude, the beam footprint will be 20-30km across (still small enough to be useful in isolating species from individual terrains), with ions striking the surface about 3 seconds after emission. Ions sputtered from the surface will be emitted with a typical energy of a few tens of eV, or a velocity of a few km/s, meaning it may take around one minute for the ions to reach the spacecraft altitude. Thus the beam should be aimed somewhat ahead of the vehicle, so that the vehicle will fly through the sputtered cloud a minute later. (In fact sputtering yields are typically higher for incidence angles of 60-80 degrees anyway.) One assumes the ions are emitted isotropically, with a yield of order 0.1, so around 10(exp 19) ion/s are deposited on a hemisphere of 6 x 10(exp 10)/sq m area. A typical ion spectrometer collection area of 10 sq cm should therefore capture approx. 10(exp 6) ions/s. This back-of-the-envelope calculation indicates that the technique should at least be possible. The technique performs better (as does most remote sensing) at shorter distances: lower altitudes would improve the spatial resolution of the technique and minimize spread of the emitted ions, both due to time-of-flight effects and bending in the ambient magnetic field. It is likely that the JIMO mission may in any case carry some sort of mass spectrometer as a space physics/magnetosphere payload, and propulsion system diagnostic. It is presumably safe to assume that the mass and energy range accommodated by the instrument is adequate to cover species of interest sputtered from the surface. It should be ensured that the sensing aperture can be oriented appropriately (i.e., somewhat orthogonal to the propulsion system.) A useful capability would be to modulate or chop the ion beam (either by physical obstruction, or by pulsing the gas valves) in order to enable discrimination of ions sputtered by the thruster beam from those sputtered by magnetospheric particles. The ability to change the grid voltage on the rusters (and thus the energy of the ions in the beam) would also be useful. Applying full thrust to JIMO for SIMS purposes will of course introduce perturbations to the JIMO orbit; with the beam aimed down and ahead of the vehicle, JIMO's orbital energy will be reduced (although perhaps negligibly, if the beam is close to vertical). Thus this type of observation may be best performed during the arrival/orbit contraction phase of a satellite encounter.
Author
Ion Probes; Ion Propulsion; Mass Spectrometers; Interplanetary Spacecraft; Satellite Surfaces; Secondary Ion Mass Spectrometry

20030066071 Arizona Univ., Tucson, AZ, USA
High-Resolution Imaging and Topography from JIMO: The HiRISE Model
McEwen, A. S.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 50; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

MRO/HiRISE: The Mars Reconnaissance Orbiter (MRO) is expected to launch in August 2005, including the High Resolution Imaging Science Experiment (HiRISE). The HiRISE camera, features a 0.5 m telescope, 12 m focal length, and 14 CCDs. Imaging is in pushbroom mode, but with Time Delay and Integration (TDI) over 128 lines to increase signal:noise ratio. Basic capabilities are summarized. We expect to acquire approximately 10,000 observations in the first Mars year, including approximately 2,000 images for 1,000 stereo targets. Each observation will be accompanied by approximately 6 m/pixel image over a 30 x 45 km region acquired by MRO's context imager. Many HiRISE images will be full resolution in the center portion of the swath width and binned (typically 4x4) on the sides. This provides two steps of context, so we zoom out from 0.3 m/pixel to 1.2 m/pixel to 6 m/pixel (at 300 km altitude). Given the science objectives of MRO, the key HiRISE capabilities in order of priority are: (l) Achieve the highest possible spatial resolution and detection of surface features. We expect to detect 1-meter-scale and begin to characterize objects or landforms with dimensions of 2 meters; (2) Achieve high-resolution topographic data from images and Digital Elevation Models (DEMs). We expect to achieve a vertical precision of approximately 0.2 cm over areas of 3x3 or 4x4 pixels (approximately one square meter on the ground); (3) Acquire observations in up to 3 colors with high radiometric fidelity. HiRISE color images at submeter scales, correlated to mineralogies of interest in the search for life, may enable identification from orbit of specific outcrops of interest for in situ analysis or sample return.
Derived from text
CCD Cameras; Satellite Instruments; Imaging Techniques; High Resolution; Topography; Terrain Analysis; Satellite Surfaces; Galilean Satellites

20030066081 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Miniaturized Plasma and Neutral Diagnostics for JIMO
McHarg, M. G.; Enloe, C. L.; Krause, L. A.; Herrero, F. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 52; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

We describe a miniaturized suite of instruments which provides both bulk energy resolved plasma properties and coarse neutral mass spectroscopy suitable for measurements on the Jupiter Icy Moons Orbiter (JIMO). The suite is comprised of two instruments; the Miniaturized Electro-Static Analyzer (MESA), and the Flat Plasma Spectrometer (FLAPS), designed to measure the near earth environment on the Air Force Academy small satellite missions Falconsat-2 and 3.
Derived from text
Spacecraft Instruments; Structural Design; Mass Spectroscopy; Spectrometers; Charged Particles; Plasma Diagnostics

20030066189 RAND Corp., Santa Monica, CA
Alternatives for Landmine Detection
MacDonald, Jacqueline; Lockwood, J. R.; McFee, John; Altshuler, Thomas; Broach, Thomas; Jan. 2003; 351 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413772; RAND/MR-1608-OSTP; No Copyright; Avail: CASI; A16, Hardcopy

Antipersonnel mines remain a significant international threat to civilians despite recent intense efforts by the USA, other developed countries, and humanitarian aid organizations to clear them from postconflict regions. Mines claim an estimated 15,000-20,000 victims per year in some 90 countries. They jeopardize the resumption of normal activities-from subsistence farming to commercial enterprise-long after periods of conflict have ceased. For example, in Afghanistan during 2000, mines claimed 150-300 victims per month, half of them children. Although most of these mines were emplaced during the Soviet occupation of Afghanistan (from 1979 to 1988), they continue to pose a serious risk to returning refugees and have placed vast tracts of farmland off limits. The USA currently invests about $100 million annually in humanitarian mine clearance-the largest commitment of any country. Despite this investment and the funding from many other developed nations and nongovernmental organizations, at the current rate clearing all existing mines could take 450-500 years.
DTIC
Mines (Ordnance); Detection

36
LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

20030065607 Amirkabir Univ., Tehran, Iran (Islamic Republic of)
Ablation Studies of Enamel Tissue Using Pulsed HF Laser
Khosroshahi, M. E.; Ghasemi, B. A.; Oct. 25, 2001; 5 pp.; In English; 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 25-28 Oct. 2001, Istanbul, Turkey
Report No.(s): AD-A412800; No Copyright; Avail: CASI; A01, Hardcopy

We describe studies of the interaction of about 400 ns duration, multiline (2.6-3) micrometer HF laser with enamel tissue. The etch rate experiment showed an ablation threshold fluence of 47 J/sq cm but using the dispersion theory for optical coefficients of n and k for enamel at dominant laser lines, this value reduced to about 25 J/sq cm making it more comparable with other investigations. The main mechanism of enamel ablation at 2.78 micrometer where its absorption is very high thought to be due to microexplosive evaporation of water within enamel matrix ie. thermomechanical decomposition. Also, using photothermal deflection technique showed that at fluences below threshold a considerable amount of heat was emitted from the surface which was detected as a single compressive wave. The spectroscopic studies indicated that calcium was the main chemical element observed in plasma spanning from (420-620)nm.
DTIC
Ablation; Enamels; Hf Lasers; Pulsed Lasers

20030065627 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
High Energy Laser Pointing Through Extended Turbulence
Tellez, Jason A.; Sep. 2002; 67 pp.; In English
Report No.(s): AD-A414046; AFIT/GE/ENG/02-31; No Copyright; Avail: CASI; A04, Hardcopy

The airborne laser (ABL) uses adaptive optics to compensate the atmospheric turbulence between the ABL and the target. The primary purpose of this compensation is to increase the energy density of the energy laser at the target. However, the specifics of the engagement scenario require the tracking point of reference and the adaptive optics point of reference to be located at different points on the target. This research considers the effects of tracking a target in one direction while compensating for atmospheric turbulence in a different directions. The target references used are a point source and a rectangle, while a point source alone is used for the adaptive optics reference. It will be shown that compensating for atmospheric turbulence in a different direction than tracking results in a bias in the mean tracking error while having no appreciable affect on track jitter.
DTIC
Airborne Lasers; High Power Lasers; Atmospheric Turbulence; Turbulence; Adaptive Optics

20030065714 Duke Univ., Durham, NC
Imaging and Interactions of Lithium Fermions in an Ultrastable CO2 Laser Trap
Thomas, J. E.; Oct. 2002; 17 pp.; In English
Contract(s)/Grant(s): DAAD19-99-1-0264
Report No.(s): AD-A414137; ARO-40021.1-PH; No Copyright; Avail: CASI; A03, Hardcopy

This program explores fundamental interactions in multi-component Fermi gases. Since single component Fermi gases do not interact at low temperatures as a consequence of the Pauli exclusion principle, it is necessary to trap and cool more than one fermionic species in order to study interactions. In current experiments, 40K and 6Li are considered particularly promising for observation of superfluidity in a Fermi gases, because these atoms exhibit magnetically tunable Feshbach resonances in their scattering interactions. The predicted superfluidity is an atomic gas analog of a superconducting transition. For systems with resonant interactions, transition temperatures of up to half the Fermi temperature are predicted. This would make these atomic systems the highest temperature superconductors ever studied, in units of the Fermi temperature. However, the most interesting mixtures of these Fermi gases must be confined in an all-optical trap, because the states of interest are repelled from magnetic traps.
DTIC
Lithium; Carbon Dioxide Lasers; Fermions; Superconductivity

20030065732 Illinois Univ., Urbana, IL, USA
Ultrafast Vibrational Spectrometer for Engineered Nanometric Energetic Materials
Dlott, Dana D.; Jan. 3, 2002; 3 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0558
Report No.(s): AD-A414089; ARO-42661.1-EG-NT; No Copyright; Avail: CASI; A01, Hardcopy

The proposer requested funding for laser equipment that would be used to study engineered nanometric energetic materials consisting of nanometer metal particles, passivation layers and oxidizing binders. The laser equipment is set up for vibrational sum-frequency generation spectroscopy, which looks at the vibrational transitions of molecules at interfaces between metal particles, their passivation layer and the surrounding oxidizer, in real time while the material is being combusted by a carbon dioxide laser. Interface spectroscopy is crucial because almost all of the relevant chemistry in nanoenergetic materials occurs at interfaces. The needed equipment was ordered and installed, and assembled into a working SFG set up that has been tested on a model system consisting of a self assembled monolayer of alkane on gold. The next step will be to finish integrating the carbon dioxide laser system and to begin looking at aluminum based energetic materials.
DTIC
Vibration; Spectrometers; Energetic Particles; Nanotechnology

20030065752 Air Force Inst. of Tech., Wright-Patterson AFB, OH
Single-Mode Raman Fiber Laser in a Multimode Fiber
Crookston, Matthew B.; Mar. 2003; 55 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412880; AFIT/GAP/ENP/03-03; No Copyright; Avail: CASI; A04, Hardcopy

The feasibility of a transverse single-mode Raman fiber laser using a multimode fiber has been investigated. The Raman fiber laser operates in low-order transverse modes despite the fact the fiber supports multimode beam propagation. The performance characteristics of the Raman fiber laser are compared with those of the single-pass SRS beam.
DTIC
Raman Spectroscopy; Multimode Resonators

20030065782 Innovative Scientific Solutions, Inc., Dayton, OH, USA
Advanced Laser Diagnostic Applications. Volume 1 of 3 (Pages 1 - 217)
Goss, Larry P.; Mar. 2001; 224 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-95-C-2507; Proj-3048
Report No.(s): AD-A413845; TR-2507-FINAL; AFRL-PR-WP-TP-2002-200-VOL-1; No Copyright; Avail: CASI; A10, Hardcopy

Reported are results of experimental and numerical investigations on gas turbine combustion and fuel processes, including: 1) Development, evaluation, and utilization of advanced laser diagnostic and analytical techniques for studying combustion and fuel processes important to current and future military aircraft; 2) Determination of cause and investigation of schemes to eliminate combustion and thermal-stability-related problems resulting from change from JP-4 to JP-8 fuel; 3) Proposal and evaluation of advanced combustor concepts and design characteristics to optimize tradeoffs in performance, visual observables, durability, and pollutants; 4) Investigation of methods for reducing emissions of carbon monoxide, hydrocarbons, oxides of nitrogen, and smoke in current and future gas turbine combustors; 5) Design and completion of experiments for establishing a database for developing and evaluating combustor and fuel-system-component design models; 6) Development of computational-fluid-dynamics (CFD) models for gas turbine combustor and fuel-system-component design; 7) Evaluation of additive and advanced thermally stable fuels that provide thermal stability up to 900 deg F; 8) Evaluation of thermally stable and environmentally safe anti-icing additives for JP-8 and JP-900 fuels; 9) Investigation of methods of using fuel to cool hot engine components and determination of impact of fuel phase change on combustion, and 10) Investigation of new military and commercial applications for combustion and fuels technology developed in this program, including high-cycle fatigue and aging aircraft.
DTIC
Computational Fluid Dynamics; Gas Turbines; Laser Applications; Exhaust Gases; Jet Engines; Diagnosis

20030066060 Washington Univ., Seattle, WA, USA
High-Spectral-Resolution 6 to 12-microns Reflection Spectroscopy of the Icy Galilean Satellites
Hibbitts, C. A.; Hansen, G. B.; McCord, T. B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 33; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

High-spectral resolution Infrared spectra of materials in the 6 to 12 micron region contain absorption bands that are capable of discriminating organic and inorganic materials on the icy Galilean satellites. This spectral region contains strong absorption features of bonds common in organic materials C=H, SO bonds, C=N, S-H, HCO3, and other features diagnostic of inorganic materials such as O3, sulfates, H2O2, and rock-forming silicate minerals. However, their surfaces are too cold to observe at high spectral resolution in emission and are too dark to observe by reflected sunlight. Modern advances in lasing technology may offer a solution. Quantum cascade (QC) lasers are a recent development that allows high power to be delivered by small, light weight devices over a 'broad' wavelength range.
Derived from text
Quantum Cascade Lasers; Absorption Spectra; High Resolution; Galilean Satellites; Absorption Spectroscopy

37
MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

20030065799 Army Research Lab., Aberdeen Proving Ground, MD
Powder Coatings as an Environmentally Acceptable Alternate to the System of MIL-P-53022 and MIL-PRF-22750
Duncan, Jeffrey L.; May 2003; 16 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413839; ARL-TR-2965; No Copyright; Avail: CASI; A03, Hardcopy

In late 2000, Albany Marine Corps Logistics Base (MCLB) personnel contacted the Coatings Technology Team, Weapons and Materials Research Directorate, US army Research Laboratory (ARL) about a test program designed to approve the use of epoxy powder coatings as replacements for the standard chemical agent resistant coating (CARC) system used on tactical equipment, because ARL is the CARC Commodity Manager and the CARC approving authority for the Department of Defense. The powder coatings were to be used on a variety of equipment to replace the military specification MIL-P-53022 (1) epoxy primer and MIL-PRF-22750 (2) epoxy topcoat as applied to bare and pretreated aluminum and zinc phosphate

pretreated steel. Normally, substitutions are for cases where those specifications do not meet volatile organic compounds (VOC) regulations in force or where new technology will provide more general benefits in the future or a more environmentally acceptable process for the user. Although these specification coatings are available in low-VOC formulations, the environmental benefits (zero VOC) and performance enhancements of powder coatings are well documented. The proposed test program ARL's approval process fell under the auspices of ARL's Experimental Products Program (EPP), which is set up to evaluate performance alternatives to military specification finishing systems. After discussions to set the number and type of panels required, panels were submitted for three powder coatings on three different substrates.
DTIC
Powder (Particles); Protective Coatings

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*.

20030065867 Accudyne Systems, Inc., Newark, DE, USA
Developing A Contoured Deposition Head for In-Situ Tape Laying and Fiber Placement
Lamontia, Mark A.; Gruber, Mark B.; Funck, Steve B.; Waibel, Brian; Cope, Ralph D.; Hulcher, A. Bruce; [2003]; 15 pp.; In English; Sampe International Symposium and Exhibition, 12-16 May 2003, Long Beach, CA, USA
Contract(s)/Grant(s): NAS8-00193; Copyright; Avail: CASI; A03, Hardcopy

A conformable compaction system employing three individual compactors has been designed for integration into fiber placement and tape laying deposition heads for out-of-autoclave fabrication of thermoplastic contoured parts. The compactors are intended to perform against two geometry specifications: (1) a general minimum radius of curvature limit of 180cm (71-in), and (2) a pad-up specification with a maximum height of 2.5mm (0.1-in) and a minimum ramp of 2.5mm (1-in). The mirrored specification is applicable to a pan-down. The three designs include a hot line compactor capable of a 1000N (400-lb) force at 450C over a 114mm (4.5-in) width, a hot area compactor capable of a 400N (100-lb) force at 450C over a 114mm width by 76mm length (4.5-in by 3-in), and a cold compactor that combines the features of a line and an area compactor. The cold compactor s line segments act with a 2800N (700-lb) force across a 127mm (5-in) width, while the cold compactor's area segments act with a 1000N (250-lb) force over a 127mm by 102mm (5-in by 4-in) area. Two of the designs, the hot line and hot area compactors, have been constructed, developed, and proven out in hot mode to compact actual thermoplastic composite plies over undulating geometry. IM-7PEEK [0/90/0/90]s pan-down and IM-7PEEK [0/-45/90/45]2s pad-up laminates have been fabricated and photomicrographs show good microstructure.
Author
Thermosetting Resins; Thermoplasticity; Thermoplastic Resins; Compacting; Fiber Strength; Microstructure; Deposition

20030065873 NASA Langley Research Center, Hampton, VA, USA
Buckling Of Long Compression-Loaded Anisotropic Plates Restrained Against Inplane Lateral and Shear Deformations
Nemeth, Michael P.; [2003]; 37 pp.; In English; 44th AIAA/ASME/ASCE/AHS/ASC Structure, Structural Dynamics and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Report No.(s): AIAA Paper 2003-1789; No Copyright; Avail: CASI; A03, Hardcopy

An approach for synthesizing buckling results and behavior for thin balanced and unbalanced symmetric laminates that are subjected to uniform axial compression loads and elastically restrained against inplane expansion, contraction, and shear deformation is presented. This approach uses a nondimensional analysis for infinitely long, flexurally anisotropic plates (coupling between bending and twisting) that are subjected to combined mechanical loads and is based on nondimensional parameters. In addition, nondimensional loading parameters are derived that account for the effects of the elastic inplane deformation restraints, membrane orthotropy, and membrane anisotropy on the induced prebuckling stress state. The loading parameters are used to determine buckling coefficients that include the effects of flexural orthotropy and flexural anisotropy. Many results are presented, for some selected laminates, that are intended to facilitate a structural designer's transition to the use of the generic buckling design curves that are presented and discussed in the paper. Several buckling response curves are presented that provide physical insight into the behavior for combined loads, in addition to providing useful design data. An example is presented that demonstrates the use of the generic design curves, which are applicable to a wide range of laminate

constructions. The analysis approach and generic results indicate the effects and characteristics of laminate orthotropy and anisotropy in a very general and unifying manner.
Author
Axial Compression Loads; Anisotropic Plates; Shear Properties; Deformation; Buckling

20030065883 Mississippi State Univ., Mississippi State, MS, USA
Reliability Sensitivity Analysis and Design Optimization of Composite Structures Based on Response Surface Methodology
Rais-Rohani, Masoud; [2003]; 25 pp.; In English
Contract(s)/Grant(s): NAG1-02099; No Copyright; Avail: CASI; A03, Hardcopy

This report discusses the development and application of two alternative strategies in the form of global and sequential local response surface (RS) techniques for the solution of reliability-based optimization (RBO) problems. The problem of a thin-walled composite circular cylinder under axial buckling instability is used as a demonstrative example. In this case, the global technique uses a single second-order RS model to estimate the axial buckling load over the entire feasible design space (FDS) whereas the local technique uses multiple first-order RS models with each applied to a small subregion of FDS. Alternative methods for the calculation of unknown coefficients in each RS model are explored prior to the solution of the optimization problem. The example RBO problem is formulated as a function of 23 uncorrelated random variables that include material properties, thickness and orientation angle of each ply, cylinder diameter and length, as well as the applied load. The mean values of the 8 ply thicknesses are treated as independent design variables. While the coefficients of variation of all random variables are held fixed, the standard deviations of ply thicknesses can vary during the optimization process as a result of changes in the design variables. The structural reliability analysis is based on the first-order reliability method with reliability index treated as the design constraint. In addition to the probabilistic sensitivity analysis of reliability index, the results of the RBO problem are presented for different combinations of cylinder length and diameter and laminate ply patterns. The two strategies are found to produce similar results in terms of accuracy with the sequential local RS technique having a considerably better computational efficiency.
Author
Structural Reliability; Reliability Analysis; Sensitivity Analysis; Design Optimization; Composite Structures

20030065917 NASA Langley Research Center, Hampton, VA, USA
Photogrammetric Measurement of Gossamer Spacecraft Membrane Wrinkling
Pappa, Richard S.; Black, Jonathan T.; Blandino, Joseph R.; [2003]; 4 pp.; In English; 2003 SEM Annual Conference and Exposition on Experimental and Applied, 2-4 Jun. 2003, Charlotte, NC, USA; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy

Photogrammetry methods are being developed for measuring the shape and dynamics of future gossamer spacecraft structures, which characteristically contain large areas of thin-film membranes. Examples include solar sails, large membrane antennas, telescope sun shields, inflatable solar arrays, space solar power collectors and transmitters, radar arrays, and planetary balloons and habitats. Membrane wrinkling (and slackening)--caused by various sources including seaming and folding, nonuniform tensioning, thermal effects, and creep--can potentially reduce performance or cause overheating or structural fatigue in space. This paper documents an experimental photogrammetric technique capable of measuring membrane wrinkle patterns and amplitudes using thousands of projected dots of light and multiple synchronized cameras. Typical results are presented for a 0.5 m x 1.0 m area of interest on a 2m square solar sail model. In this application, the photogrammetric measurement precision was approximately 25 microns (0.001 inches). The paper closes by mentioning a promising extension of existing techniques using a laser-induced fluorescence approach.
Author
Photogrammetry; Spacecraft Structures; Wrinkling

42
GEOSCIENCES (GENERAL)

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

20030065858 California Univ., Los Angeles, CA, USA
Large Aerial Bursts: An Important Class of Terrestrial Accretionary Events
Wasson, John T.; Astrobiology; [2003]; Volume 3, No. 1, pp. 163-179; In English
Contract(s)/Grant(s): NAG5-12058; NAG5-10421; Copyright; Avail: Other Sources

Large aerial bursts similar to the 1908 Tunguska bolide but much larger in magnitude have surely been responsible for many catastrophic events in the history of the Earth. Because aer- ial bursts produce shallow (or even negligible) craters, their existence is difficult to document in the geological record. Even aerial bursts as small as Tunguska deposit enough energy to melt -1 mm of dry soil. Silica-rich glass formed in such melts has the potential to survive in the soil for many Ma, thus a potential indicator of large aerial bursts is glass that was formed as thick regions within silicate melt sheets. The layered tektites from Southeast Asia and the Libyan desert glass may have formed by a combination of sedimentation and downslope flow of silicate melt heated by radiation from large aerial bursts. The alternative, formation of lay- ered tektites as crater ejecta, cannot account for observations such as uniformly high l0Be con- tents, the orientation of the magnetic remanence field, and the absence of splash-form (e.g., teardrop or dumbbell) tektites in regions where layered tektites are common. The largest as- teroids or comets make craters no matter what their strength. Recent reviews suggest that, for events in the energy range up to 1019-1020 J (about two orders of magnitude larger than the Meteor Crater impact), aerial bursts are more likely than cratering events, and the layered tek- tites of Southeast Asia imply the existence of aerial bursts one to two orders of magnitude larger still.
Author
Tektites; Southeast Asia; Ejecta

20030065978 California Univ., Los Angeles, CA, USA
Mineralogy and Petrology of Amoeboid Olivine Inclusions in CO3 Chondrites: Relationship to Parent-Body Aqueous Alteration
Chizmadia, Lysa J.; Rubin, Alan E.; Wasson, John T.; [2003]; 16 pp.; In English
Contract(s)/Grant(s): NAG5-12058; NAG5-4331; NAG5-10421; NAG5-4766; NAG5-6082; NAG3-17431; Copyright; Avail: CASI; A03, Hardcopy

Petrographic and mineralogic studies of amoeboid olivine inclusions (AOIs) in CO3 carbonaceous chondrites reveal that they are sensitive indicators of parent-body aqueous and thermal alteration. As the petrologic subtype increases from 3.0 to 3.8, forsteritic olivine (Fa(sub 0-1)) is systematically converted into ferroan olivine (Fa(sub 60-75)). We infer that the Fe, Si and O entered the assemblage along grain boundaries, forming ferroan olivine that filled fractures and voids. As temperatures increased, Fe(+2) from the new olivine exchanged with Mg(+2) from the original AOI to form diffusive haloes around low-FeO cores. Cations of Mn(+2), Ca(+2) and Cr(+3) were also mobilized. The systematic changes in AOI textures and olivine compositional distributions can be used to refine the classification of CO3 chondrites into subtypes. In subtype 3.0, olivine occurs as small forsterite grains (Fa(sub 0-1)), free of ferroan olivine. In petrologic subtype 3.2, narrow veins of FeO-rich olivine have formed at forsterite grain boundaries. With increasing alteration, these veins thicken to form zones of ferroan olivine at the outside AOI margin and within the AOI interior. By subtype 3.7, there is a fairly broad olivine compositional distribution in the range Fa(sub 63-70), and by subtype 3.8, no forsterite remains and the high-Fa peak has narrowed, Fa(sub 64-67). Even at this stage, there is incomplete equilibration in the chondrite as a whole (e.g., data for coarse olivine grains in Isna (CO3.8) chondrules and lithic clasts show a peak at Fa(sub39)). We infer that the mineral changes in A01 identified in the low petrologic types required aqueous or hydrothermal fluids whereas those in subtypes greater than or equal to 3.3 largely reflect diffusive exchange within and between mineral grains without the aid of fluids.
Author
Carbonaceous Chondrites; Mineralogy; Olivine; Petrography; Amoeba; Inclusions; Aqueous Solutions

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*.

20030065679 TRW Space and Electronics Group, Redondo Beach, CA
Biological Effects of Inadvertent Perchlorate Releases During Launch Operations
Hines, Mark E.; von Hippel, Frank; Kennish, John; Sep. 30, 2002; 45 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F04701-00-D-0203
Report No.(s): AD-A414070; No Copyright; Avail: CASI; A03, Hardcopy

Solid rocket motor fuel contains large quantities of ammonium perchlorate as the primary oxidant and this material has been shown to be toxic to life. In the event of an aborted rocket launch, it is possible that unspent propellant could be deposited

near the launch site and coastal marine and terrestrial habitats could be adversely affected. This report presents the results of the following experiments: effects of perchlorate on primary and secondary production in freshwater and marine water samples; decomposition processes in marine and freshwater sediments, freshwater wetland peat, and upland soils; effects of perchlorate on the behavior and growth of the fish species threespine stickleback; and the bioaccumulation of perchlorate by freshwater and marine plankton and in the threespine stickleback fish. Results show that perchlorate will affect photosynthesis in aquatic systems, but this effect appears to occur only when perchlorate levels are extremely high (1000 ppm). Bacterial production also was not adversely affected by the presence of perchlorate except at very high levels in seawater samples. Respiration in marine and freshwater sediments and wetland peat was not adversely affected by perchlorate concentrations as high as 1000 ppm. Soil samples exhibited significant decreases in respiration activity in the presence of 100 and 1000-ppm perchlorate, so it is possible that the deposition of perchlorate to coastal soils following a flight abortion could decrease the rate that material is decomposed in soil, which could adversely affect plant growth. The presence of potassium perchlorate at concentrations up to 10 ppm and perchlorate concentrations nearing 30 ppm in aquaria containing solid propellant had no effect on stickleback mating or the birth and growth of fry. Both the algal/bacterial and fish in aquaria accumulated significant levels of perchlorate that could be passed on to other tropic levels and later lead to deleterious effects.
DTIC
Biological Effects; Perchlorates; Spacecraft Launching; Remote Sensing; Solid Rocket Propellants

20030065956 NASA Marshall Space Flight Center, Huntsville, AL, USA
Soil Sampling Techniques For Alabama Grain Fields
Thompson, A. N.; Shaw, J. N.; Mask, P. L.; Touchton, J. T.; Rickman, D.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

Characterizing the spatial variability of nutrients facilitates precision soil sampling. Questions exist regarding the best technique for directed soil sampling based on a priori knowledge of soil and crop patterns. The objective of this study was to evaluate zone delineation techniques for Alabama grain fields to determine which method best minimized the soil test variability. Site one (25.8 ha) and site three (20.0 ha) were located in the Tennessee Valley region, and site two (24.2 ha) was located in the Coastal Plain region of Alabama. Tennessee Valley soils ranged from well drained Rhodic and Typic Paleudults to somewhat poorly drained Aquic Paleudults and Fluventic Dystrudepts. Coastal Plain s o i l s ranged from coarse-loamy Rhodic Kandiudults to loamy Arenic Kandiudults. Soils were sampled by grid soil sampling methods (grid sizes of 0.40 ha and 1 ha) consisting of: 1) twenty composited cores collected randomly throughout each grid (grid-cell sampling) and, 2) six composited cores collected randomly from a -3x3 m area at the center of each grid (grid-point sampling). Zones were established from 1) an Order 1 Soil Survey, 2) corn (Zea mays L.) yield maps, and 3) airborne remote sensing images. All soil properties were moderately to strongly spatially dependent as per semivariogram analyses. Differences in grid-point and grid-cell soil test values suggested grid-point sampling does not accurately represent grid values. Zones created by soil survey, yield data, and remote sensing images displayed lower coefficient of variations (8CV) for soil test values than overall field values, suggesting these techniques group soil test variability. However, few differences were observed between the three zone delineation techniques. Results suggest directed sampling using zone delineation techniques outlined in this paper would result in more efficient soil sampling for these Alabama grain fields.
Author
Alabama; Soil Sampling; Remote Sensing

20030066221 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Methods for Evaluation of 'L' and 'S' Factor for the Universal Soil Loss Equation (USLE) in a Watershed, Involving Geoprocessing and Database
Gameiro, Marcelo Goncalves; 2003; 138 pp.; In Portuguese; CD-ROM contains full text document in PDF format and color illustrations. PDF also has blank pages.
Report No.(s): INPE-9555-TDI/831; Copyright; Avail: CASI; C01, CD-ROM; A07, Hardcopy

This work deals with remote sensing, GIS, and database. The test site is the Ribeirao das Araras watershed, located in Araras, SP, Brazil. The Universal Soil Loss Equation (USLE) was modeled, with emphasis on the topographic factor, which is divided in slope length (L) and slope (S). Both were calculated by two different methos: L1 or method of the preferential direction by the superficial water flux; L2 or 'isocomplere' method; S1 or abacus method; S2 or grod method. The USLE C factor was calculated by two different methods: a) ancillary data from field work; b) digital image processing. It was performed a sensitivity analysis of the USLE for L and S factors. Also, it was performed a comparison between the two methods fo C calculus. Another step was to make the land suitability map using GIS coupled to a tabular database. The estimate of erosion calculated by using USLE and the soil loss tolerance allowed the generation of the criticality index. Afterwards, this index was

compared to the use adequacy map derived from the comparison between the land suitability map and the actual land use map. As a result it was found that the calculus of the C factor using digital image processing was not satisfactory. For the S factor, there was no statistical difference between the methods used in its modeling. For the L factor, there was a statistical difference between the methods used; and the 'isocomplere' method seemed to give a good representation of the reality because it presented the lowest values for L. The GIS coupled to a database was a tool very useful to generate the land suitability maps. However it was found some difficulties with data sources, mainly with the low precision of the soil map. The comparison between the land suitability map and the criticality index was coherent.
Author
Soil Erosion; Watersheds; Data Bases; Remote Sensing; Geographic Information Systems; Environment Simulation

20030066223 Texas Univ., Austin, TX, USA
Mapping Near-Surface Salinization Using Long-wavelength AIRSAR
Paine, Jeffery G.; August 2003; 67 pp.; In English
Contract(s)/Grant(s): NAG5-7582; SENH98-0113; No Copyright; Avail: CASI; A04, Hardcopy

In May 1999, NASA's Jet Propulsion Laboratory acquired airborne synthetic aperture radar (AIRSAR) data over the Hatchel and Montague Test Sites in Texas. We analyzed P- and L-band polarimetric radar data from these AIRSAR missions to assess whether AIRSAR could be used as a rapid and remote platform for screening large areas at risk for near-surface soil and water salinization. Ongoing geological, geophysical, and hydrological studies at the Hatchel Test Site in Runnels County and the Montague Test Site in Montague County have demonstrated the utility of high-resolution airborne electromagnetic (EM) induction in mapping electrical conductivity changes that accompany shallow natural and oil-field related salinization at these sites in the Colorado and Red River basins. We compared AIRSAR and airborne EM data quantitatively by (1) selecting representative flight lines from airborne EM surveys of the Hatchel and Montague sites, (2) extracting measurement locations and apparent conductivities at the highest available EM frequency, (3) identifying and extracting all P- and L-band backscatter intensities for all locations within 5 m of an airborne EM measurement, and (4) examining the spatial and magnitude relationships between apparent conductivity and all radar polarization and polarization-ratio combinations. For both test sites, backscatter intensity in all individual P- and L-band polarizations was slightly negatively correlated with apparent conductivity. In most modes this was manifested as a decrease in the range and magnitude of backscatter intensity as apparent conductivity increased. Select single-band and cross-band polarization ratios exhibited somewhat higher correlation with apparent conductivity by partly diminishing the dominance of the vegetation contribution to V backscatter intensity. The highest correlation with conductivity was obtained using the L-band vertical- to cross-polarization ratio, the P-band vertical- to L-band cross-polarization ratio, and the P-band vertical-to cross-polarization ratio. These correlations were higher for the more arid (and less electrically conductive) Hatchel Test Site than they were for the Montague Test Site.
Author
Salinity; Aerial Reconnaissance; Mapping; Polarimetry; Magnetic Induction; Electrical Resistivity

44
ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

20030065667 Vanderbilt Univ., Nashville, TN
A Monopropellant-Powered Actuator for the Development of a Lower Limb Exoskeleton
Goldfarb, Michael; Apr. 19, 2001; 16 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-00-1-0178
Report No.(s): AD-A413914; No Copyright; Avail: CASI; A03, Hardcopy

The objective of the proposed work is to develop and demonstrate an actuation system that provides direct chemical to mechanical energy conversion from an energy source that is approximately an order of magnitude more energy dense and power dense than the best commercially available lithium-thionyl-chloride or lithium-manganese-dioxide electrochemical batteries. Specifically, the proposed system utilizes the monopropellant hydrogen peroxide (H2O2) to maintain a high-pressure pneumatic reservoir, which is in turn utilized as a controllable power source for a system of pneumatic actuators. A key attribute of the proposed system is its simplicity. The monopropellant produces a low temperature reaction that generates completely benign byproducts. Additionally, the use of pneumatic actuators produces a lightweight system that is well

impedance-matched to a human operator. The one-year feasibility study will develop and demonstrate the monopropellant-powered actuator.
DTIC
Energy Conversion; Monopropellants

46
GEOPHYSICS

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

20030065655 Massachusetts Inst. of Tech., Cambridge, MA
Stratospheric Chemistry of Aluminum Oxide Particles
Meads, Roger; Spencer, Darryl; Molina, Mario J.; Jun. 1994; 13 pp.; In English
Report No.(s): AD-A413896; No Copyright; Avail: CASI; A03, Hardcopy

The emissions from solid rocket motors (SRMs) include hydrogen chloride vapor (MCi) and other inorganic chlorine compounds, as well as aluminum oxide particles. The effects of these emissions on stratospheric ozone have been investigated by Prather et al. Pyle and others. Recent satellite observations show no measurable localized depletion of ozone following a Space Shuttle launch; nevertheless, it is possible for the effects to be quite pronounced in the immediate neighborhood of the rocket plume.
DTIC
Emission; Particles; Aluminum Oxides; Plumes

20030065673 Army Research Lab., Adelphi, MD, USA
Surface Layer Stability Transition Research Maximum Time Delay from Sunrise/Non-Ideal Conditions: 2001 June Case Study
Vaucher, Gail-Tirrell; Bustillos, Manny; May 2003; 58 pp.; In English
Report No.(s): AD-A413912; ARL-TR-2823; No Copyright; Avail: CASI; A04, Hardcopy

Near surface target acquisition and EO propagation significantly improve during the Surface Layer Stability Transition (SLST). Thus, this research expands Army Chief of Staff Shinseki's vision from 'to see first' to, 'to see better. ' The SLST is also the starting and ending points for the atmospheric convection growth phase, an important factor in chemical warfare modeling. In 2001, the Meteorological-sensors Integration Team of the Army Research Laboratory conducted the second of three field tests with the primary purpose of characterizing, modeling and exploiting repeatable patterns in the lower portion of the atmospheric boundary layer. The repeatable patterns investigated were the morning Stability Transitions (ST) or Neutral Events (NE). The 2001 June 2O-22 test dates were selected based on a forecasted maximum time interval between the local Sunrise and an Ideal case NE. Two other field tests addressed the minimum Sunrise-to-NE time interval (March and September). These Tests are documented separately. The SLST Research pursued two measurement and analysis methods: Eulerian (Tower data) and quasi-Lagrangian (Rawinsonde data). The June results were as unexpected as the atypical Monsoon weather conditions observed. Excellent examples of Extended and Multiple STs were quantified by the data. A ST lasting at least 26 minutes surprised scientists by occurring well before sunrise and the morning twilight. The cumulative findings over this 2001 Solstice time period have expanded the documented character of a desert stable-neutral-unstable morning transition. The information in this report is a useful building block in support of the primary goal.
DTIC
Earth Atmosphere; Boundary Layers

20030065855 NASA Marshall Space Flight Center, Huntsville, AL, USA
Observations of the Geopause at the Equatorial Magnetopause: Density and Temperature
Chandler, M. O.; Moore, T. E.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Magnetic flux tubes containing plasmaspheric ion density and composition have been observed in the region between the classical plasmapause and the magnetopause. New observations show that these ion distributions exist at the equatorial, post-noon magnetopause. Comparison to observations of similar distributions at geosynchronous orbit and to simulations leads to the conclusion that these ions are convected from these regions to the magnetopause. This represents an extension of the

geopause to the outer edge of the magnetosphere on the dayside. The presence of ion densities > 10 cu cm in this region must have profound impact on the nature of plasma processes that occur there.
Author
Magnetopause; Plasmasphere; Ion Distribution; Ion Temperature; Magnetospheric Ion Density

20030065900 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Nonlinear Coupling of Electromagnetic Ion Cyclotron and Lower Hybrid Waves in the Ring Current Region: The Magnetic Storm May 1-7 1998
Khazanov, G. V.; Krivorutsky, E.; Gamayunov, K.; Avanov, L.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The excitation of lower hybrid waves (LHWs) is a widely discussed mechanism of interaction between plasma species in space, and is one of the unresolved questions of magnetospheric multi-ion plasmas. In this paper we present the morphology, dynamics, and level of LHW activity generated by electromagnetic ion cyclotron (EMIC) waves during the May 2-7, 1998 storm period on the global scale. The LHWs were calculated based on our newly developed self-consistent model that couples the system of two kinetic equations: one equation describes the ring current (RC) ion dynamic, and another equation describes the evolution of EMIC waves. It is found that the LHWs are excited by helium ions due to their mass dependent drift in the electric field of EMIC waves. The level of LHW activity is calculated assuming that the induced scattering process is the main saturation mechanism for these waves. The calculated LHWs electric fields are consistent with the observational data.
Author
Ion Cyclotron Radiation; Nonlinearity; Coupling; Space Plasmas; Magnetic Storms; Ring Currents; Wave Excitation; Plasma Waves

20030066153 California Univ., Los Angeles, CA, USA
Ubiquitous Low-FeO Relict Grains in Type II Chondrules and Limited Overgrowths on Phenocrysts Following the Final Melting Event
Wasson, John T.; Rubin, Alan E.; Geochimica et Cosmochimica Acta; [2003]; ISSN 0016-7037; Volume 67, No. 12, pp. 2239-2250; In English
Contract(s)/Grant(s): NAG5-12058; NAS5-10421; Copyright; Avail: Other Sources

Type II porphyritic chondrules commonly contain several large (>40 microns) olivine phenocrysts; furnace-based cooling rates based on the assumption that these phenocrysts grew in a single-stage melting-cooling event yield chondrule cooling-rate estimates of 0.01-1 K per second. Because other evidence indicates much higher cooling rates, we examined type II chondrules in the CO3.0 chondrites that have experienced only minimal parent-body alteration. We discovered three kinds of evidence indicating that only minor (4-10 microns) olivine growth occurred after the final melting event: (1) Nearly all (>90%) type II chondrules in CO3.0 chondrites contain low-FeO relict grains; overgrowths on these relicts are narrow, in the range of 2-12 microns. (2) Most type II chondrules contain some FeO-rich olivine grains with decurved surfaces and acute angles between faces indicating that the grains are fragments from an earlier generation of chondrules; the limited overgrowth thicknesses following the last melting event are too thin to disguise the shard-like nature of these grains. (3) Most type II chondrules contain many small (<20 micron) euhedral or subhedral phenocrysts with central compositions that are much more ferroan than the centers of the large phenocrysts: their small sizes document the small amount of growth that occurred after the final melting event. If overgrowth thicknesses were small (4-10 microns) after the final melting event, it follows that large fractions of coarse (>40 microns) high-FeO phenocrysts are relicts from earlier generations of chondrules, and that cooling rates after the last melting event were much more rapid than indicated by models based on a single melting event. These observations are thus inconsistent with the classic igneous model of formation of type II porphyritic chondrules by near-total melting of a precursor mix followed by olivine nucleation on a very limited number of nuclei (say, less than or equal to 10) and by growth to produce the large phenocrysts during a period of monotonic (and roughly linear) cooling. Our observations that recycled chondrule materials constitute a large component of the phenocrysts of type II chondrules also imply that this kind of chondrule formed relatively late during the chondrule-forming period.
Author
Chondrule; Iron Oxides; Melting; Meteoritic Composition; Petrology; Granular Materials

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20030065690 Woods Hole Oceanographic Inst., MA
Long-Term Evolution of the Coupled Boundary Layers (Stratus) Mooring Recovery and Deployment Cruise Report R/V Melville
Hutto, Lara; Weller, Robert; Lord, Jeff; Ryder, Jim; Stuart-Menteth, Alice; Jan. 2003; 154 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NA17RJ1223
Report No.(s): AD-A413253; WHOI-2003-01; No Copyright; Avail: CASI; A08, Hardcopy

The Long Term Evolution and Coupling of the Boundary Layers Study (referred to as the Stratus Project) is an effort to obtain a reliable multi-year dataset of meteorological and subsurface measurements beneath the stratus cloud deck off the coast of Chile and Peru. This data will improve our understanding of the role of clouds in ocean-atmosphere coupling. This project is part of the Eastern Pacific Investigation of Climate (EPIC), a NOAA-funded Climate Variability (CLIVAR) study.
DTIC
Boundary Layers; Deployment; Meteorological Parameters; Stratus Clouds; Climatology

20030065724 Naval Research Lab., Stennis Space Center, MS
Coupling GLERL with RAMS to Study Surface Wind Wave Effects on Air-Sea Fluxes in Chesapeake Bay
Lin, Weiqi; Sanford, Lawrence; McQueens, Jeff; Suttles, Steven; Hwang, Paul A.; Oct. 25, 2002; 19 pp.; In English
Contract(s)/Grant(s): N00014-98-1-0837
Report No.(s): AD-A414195; NRL/PP/7330/02/0092; No Copyright; Avail: CASI; A03, Hardcopy

Surface wind waves play an important role in the air-sea transfer of momentum, mass and heat. Several field experiments reported that wave age, C/u. (Cp is the wave phase velocity at spectral peak), is an important parameter for determining air-sea drag coefficient, Cd, or surface roughness length, Zg (Donelan 1990; Geemaert et al. 1987; Smith et al. 1992; Lin 2000; Lin et al. 2002). Other theoretical or modeling studies (Janssen 1989,1991) also suggested that wave age is a controlling factor for determining Zg. Wave breaking generates air bubbles and significantly enhances gas transfer over water surface (Loewen 2002). Most recently, Deane and Stokes (2002) found that the size distribution of the entrained bubbles is critical to the way that air and sea interacts.
DTIC
Surface Waves; Air Water Interactions; Chesapeake Bay (Us); Aerodynamic Coefficients

20030065797 Massachusetts Inst. of Tech., Cambridge, MA, USA
Laboratory Studies of Homogeneous and Heterogeneous Chemical Processes of Importance in the Upper Atmosphere
Molina, Mario J.; July 2003; 11 pp.; In English
Contract(s)/Grant(s): NAG5-8887; No Copyright; Avail: CASI; A03, Hardcopy

The objective of this study was to conduct measurements of chemical kinetics parameters for reactions of importance in the stratosphere and upper troposphere, and to study the interaction of trace gases with ice surfaces in order to elucidate the mechanism of heterogeneous chlorine activation processes, using both a theoretical and an experimental approach. The measurements were carried out under temperature and pressure conditions covering those applicable to the stratosphere and upper troposphere. The main experimental technique employed was turbulent flow-chemical ionization mass spectrometry, which is particularly well suited for investigations of radical-radical reactions.
Derived from text
Heterogeneity; Upper Atmosphere; Chemical Reactions; Atmospheric Composition; Homogeneity

20030066164 NASA Marshall Space Flight Center, Huntsville, AL, USA
Doppler Radar and Lightning Network Observations of a Severe Outbreak of Tropical Cyclone Tornadoes
McCaul, Eugene W., Jr.; Buechler, Dennis; Goodman, Steven; Cammarata, Michael; June 2003; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

Data from a single WSR-88D Doppler radar and the National Lightning Detection Network are used to examine in detail the characteristics of the convective storms that produced a severe tornado outbreak within Tropical Storm Beryl's remnants on 16 August 1994. Comparison of the radar data with reports of tornadoes suggests that only 13 cells produced the 29

tornadoes that were documented in Georgia and the Carolinas on that date. Six of these cells spawned multiple tornadoes, and the radar data confirm the presence of miniature supercells. One of the cells was identifiable on radar for 11 hours, spawning tornadoes over a time period spanning approximately 6.5 hours. Several other tornadic cells also exhibited great longevity, with cell lifetimes greater than ever previously documented in a landfalling tropical cyclone tornado event, and comparable to those found in major midlatitude tornadic supercell outbreaks. Time-height analyses of the three strongest tornadic supercells are presented in order to document storm kinematic structure and to show how these storms appear at different ranges from a WSR-88D radar. In addition, cloud-to-ground (CG) lightning data are examined for the outbreak, the most intense tropical cyclone tornado event studied thus far. Although the tornadic cells were responsible for most of Beryl's CG lightning, flash rates were only weak to moderate, even in the most intense supercells, and in all the tornadic storms the lightning flashes were almost entirely negative in polarity. A few of the single-tornado storms produced no detectable CG lightning at all. In the stronger cells, there is some evidence that CG lightning rates decreased during tornadogenesis, as has been documented before in some midlatitude tornadic storms. A number of the storms spawned tornadoes just after producing their final CG lightning flashes. Surprisingly, both peak currents and positive flash percentages were larger in Beryl s nontornadic storms than in the tornadic ones. Despite some intriguing patterns, the CG lightning behavior in this outbreak remains mostly inconsistent and ambiguous, and offers only secondary value for warning guidance. The present findings argue in favor of the implementation of observing systems capable of continuous monitoring of total lightning activity in storms. Author

Cloud-To-Ground Discharges; Radar Data; Tornadoes; Cyclones; Doppler Radar; Tropical Storms

20030066219 NASA Marshall Space Flight Center, Huntsville, AL, USA

A Variational Analysis of Divergence Profiles Based upon Column-Integrated Mass, Moisture and Energetic Constraints with Satellite-Derived Boundary Fluxes

Lu, Huei-Lin; Robertson, Franklin R.; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

A diagnostic study is made of the mean global divergent circulation based upon a constrained least action principle that minimizes column-integrated divergent kinetic energy subject to constraints on mass, moisture, available potential energy (ape) and total kinetic energy. The concept of gross moist stability was incorporated in the prescription of Lagrange weight function associated with the ape constraint in order to simulate the net effects of cumulus convective heating in the tropics. The variational analyses were validated satisfactorily with the original NCEP/NCAR-reanalysis divergence fields for the Septembers of 1987 and 1988. Further analyses show that in the tropical ascending regions, the analyzed divergences are dominated by the mass and ape constraints; the moisture constraint is implicitly satisfied while the kinetic energy constraint is highly dependent on the ape constraint. In the subtropical descending regions, the analyzed divergences are dominated by the mass, moisture and kinetic energy constraints; the ape constraint is implicitly satisfied. When the constraint integrals were blended with the satellite-derived boundary flux data from GPCP precipitation and ERBE/SRB radiation estimates, the newly analyzed divergences are significantly stronger than the reanalysis divergences in the areas where the estimates of precipitation rates are higher. With few exceptions, the increases in upper-layer divergences are coupled with nearly equal increases in lower-layer convergences.

Author

Convergence; Kinetic Energy; Potential Energy; Moisture; Convective Heat Transfer; Earth Radiation Budget Experiment

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*.

20030066106 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Deviation of Long-Period Tides from Equilibrium: Kinematics and Geostrophy

Egbert, Gary D.; Ray, Richard D.; Journal of Physical Oceanography; April 2003; Volume 33, No. 4, pp. 822-839; In English Contract(s)/Grant(s): NSF OCE-96-33527; NSF OCE-98-19518; Copyright; Avail: CASI; A03, Hardcopy

New empirical estimates of the long-period fortnightly (Mf) tide obtained from TOPEX/Poseidon (T/P) altimeter data confirm significant basin-scale deviations from equilibrium. Elevations in the low-latitude Pacific have reduced amplitude and lag those in the Atlantic by 30 deg or more. These interbasin amplitude and phase variations are robust features that are reproduced by numerical solutions of the shallow-water equations, even for a constant-depth ocean with schematic interconnected rectangular basins. A simplified analytical model for cooscillating connected basins also reproduces the

principal features observed in the empirical solutions. This simple model is largely kinematic. Zonally averaged elevations within a simple closed basin would be nearly in equilibrium with the gravitational potential, except for a constant offset required to conserve mass. With connected basins these offsets are mostly eliminated by interbasin mass flux. Because of rotation, this flux occurs mostly in a narrow boundary layer across the mouth and at the western edge of each basin, and geostrophic balance in this zone supports small residual offsets (and phase shifts) between basins. The simple model predicts that this effect should decrease roughly linearly with frequency, a result that is confirmed by numerical modeling and empirical T/P estimates of the monthly (Mm) tidal constituent. This model also explains some aspects of the anomalous nonisostatic response of the ocean to atmospheric pressure forcing at periods of around 5 days.
Author
Tides; Deviation; Equilibrium; Periodic Variations; Elevation; Numerical Analysis; Mathematical Models; Kinematics; Structural Basins

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*.

20030065853 NASA Ames Research Center, Moffett Field, CA, USA
All the Parathyroids, All the Time: The Parathyroids, Basic and Clinical Concepts
Arnaud, Sara B.; TRENDS in Endocrinology and Metabolism; April 2003; ISSN 1043-2760; Volume 14, No. 3, pp. 104-105; In English
Contract(s)/Grant(s): RTOP 111-40-10; Copyright; Avail: Other Sources

The second edition of The Parathyroids, Basic and Clinical Concepts is a comprehensive source of information that most endocrinologists will want to have on their bookshelves. Not only does it describe the basic physiology of the parathyroids, but also the clinical aspects of hyper- and hypoparathyroid states. The authors have retained the general organization of the first edition but have updated and revised all the sections and added a few new chapters. The list of authors is impressive, comprising the many students of G. Auerbach, whose laboratory isolated the hormone and whose untimely death ten years ago inspired the first edition of the book. The younger generation of scientists from several other laboratories, who have made significant contributions to parathyroid physiology and molecular genetics, are also included. Chapters about the presentation of clinical primary hyperparathyroidism in Europe, India, Brazil and China are of particular interest. Classic features of the disease are found that contrast with the often asymptomatic disease found in the West, which is discovered through modest increases in serum calcium from biochemical screening.
Author
Parathyroid Gland; Biochemistry; Endocrinology; Physiology; Literature

20030065868 NASA Marshall Space Flight Center, Huntsville, AL, USA
Indigenous and Contaminant Microbes in Ultradeep Mines
Onstott, T. C.; Moser, D. P.; Pfiffner, S. M.; Fredrickson, J. K.; Brockman, F. J.; Phelps, T. J.; White, D. C.; Peacock, A.; Balkwill, D.; Hoover, R. B., et al.; [2003]; 3 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

Rock, air and service water samples were collected for microbial analyses from 3.2 kilometers depth in a working Au mine in the Witwatersrand basin, South Africa. The approx. 1 meter wide mined zone was comprised of a carbonaceous, quartz, sulfide, uraninite and Au bearing layer, called the Carbon Leader, sandwiched by quartzite and conglomerates. The microbial community in the service water was dominated by mesophilic aerobic and anaerobic, alpha, beta, and gamma-Proteobacteria with a total biomass concentration approx. 10(exp 4) cells/ml, whereas, that of the mine air was dominated by members of the Chlorobi and Bacteroidetes groups and a fungal component. The microorganisms in the Carbon Leader were predominantly mesophilic, aerobic heterotrophic, nitrate reducing and methylotrophic, beta and gamma-Proteobacteria that were more closely related to service water microorganisms rather than air microbes. Rhodamine WT dye and fluorescent microspheres employed as contaminant tracers, however, indicated that service water contamination of most of the rock samples was < 0.01% during acquisition. The microbial contaminants most likely originated from the service water, infiltrated the low permeability rock through and accumulated within mining-induced fractures where they survived for several days prior to being mined. Combined PLFA and terminal restriction fragment length profile (T-RFLP) analyses suggest that the maximum concentration of indigenous microorganisms in the Carbon Leader was < 10(exp 2) cells/g. PLFA, (35)S

autoradiography and enrichments suggest that the adjacent quartzite was less contaminated and contained approx. 10(exp 3) cells/gram of a thermophilic, sulfate reducing bacteria, SRB, some of whom are delta Proteobacteria. Pore water and rock geochemical analyses suggest that these SRB's may have been sustained by sulfate diffusing from the adjacent U-rich, Carbon Leader where it was formed by radiolysis of sulfide.
Author
Microorganisms; Mines (Excavations); Contamination; Air Sampling; Water Sampling; Mesophiles; Fungi; Thermophiles

20030065875 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thermococcus Thioreducens sp. nov., A Novel Hyperthermophilic, Obligately Sulfur-Reducing Archaeon from a Deep-Sea Hydrothermal Vent
Pikuta, Elena V.; Hoover, Richard B.; Marsic, Damien; Bej, Asim K.; Garriott, Owen; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources

A novel hyperthermophilic organo-heterotrophic archaeon, strain OGL-20P(sup T), was isolated from 'black smoker' chimney material from the Rainbow hydrothermal vent site on the Mid-Atlantic Ridge (36.2 N; 33.9 W). The cells of strain OGL-20P(sup T) have an irregular coccoid shape and are motile with a single flagellum. Growth was observed to occur within the pH range 5.0-8.5 (optimum pH 7.0), NaCl concentration range 1-5 % (w/v) (optimum 3 %), and temperature range 55-94 C (optimum 83-85 C). Novel isolate is strictly anaerobic and obligately dependent from elemental sulfur as electron acceptor, but it cannot reduce sulfate, sulfite, thiosulfate, iron (III) or nitrate. Proteolysis products that can be utilized as substrates during sulfur-reduction are: peptone, bactotryptone, casamino-acids, and yeast extract. Strain OGL-20P(sup T) is resistant to ampicillin, chloramphenicol, kanamycin, and gentamycin, but sensitive to tetracycline and rifampicin. The G+C content of DNA is 57.1 mol% . Comparative 16S rRNA gene sequence analysis revealed that strain OGL-20P(sup T) is most closely related to Thermococcus celer and 'T. barossii', but no significant homology by DNA-DNA hybridization was observed between those species and the new isolate. On the basis of physiological and molecular properties of the new isolate, the name Thermococcus thioreducens sp. nov., is proposed. The type strain is OGL-20P(sup T) (= ATCC BAA-394(sup T) = DSM 1498(sup T)).
Author
Archaebacteria; Mid-Ocean Ridges; Ocean Bottom; Anaerobes

20030065880 NASA Marshall Space Flight Center, Huntsville, AL, USA
Gelidivirgula Patagoniensis Gen. Nov., Sp. Nov., A Novel Psychrotolerant, Sporeforming Anaerobe Isolated from Magellanic Penguin Guano in Patagonia, Chile
Pikuta, Elena V.; Hoover, Richard B.; Marsic, Damien; Whitman, William B.; Tang, Jane; Krader, Paul; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources

A novel obligately anaerobic, psychrotrophic bacterium, strain PPP2(sup T), was isolated from guano of the Magellanic penguin (Spheniscus magellanicus) in Patagonia, Chile. The Gram-positive, sporeforming, straight rods with sizes 0.6-0.9 x 3.0-5.0 microns, are motile by peritrichous flagella. Growth was observed to occur within the pH range 6.0-9.5 (optimum pH x), and temperature range 2-28 C (optimum 20 C). The novel isolate does not require NaCl for growth, but is halotolerant and growth was observed between 0 and 7 % NaCl (w/v) with optimum at 0.5 % (w/v). The new isolate is a catalase negative chemoorganohetherotroph with fermentative metabolism and uses as substrates: peptone, Bacto-tryptone, Casamino acids, and yeast extract. The major metabolic products are: acetate, butyrate, ethanol, and hydrogen is a minor gas product.. Strain PPP2 was sensitive to ampicillin, tetracycline, chloramphenicol, rifampin, kanamycin, and gentamycin. The G+C content of the DNA is 43.6 mol%. On the basis of 16S rDNA gene sequences and phenotypic characteristics, it is proposed that the strain PPP2(sup T) (= ATCC BAA-755(sup T) = JSM ...(sup T)) is assigned to the new genus Gelidivirgula gen. nov., as a representative of the new species, Gelidivirgula patagonensis sp. nov.
Author
Bacteria; Anaerobes; Growth; Ph; Temperature; Antibiotics; Metabolism; Deoxyribonucleic Acid

20030065974 NASA Ames Research Center, Moffett Field, CA, USA
Extracellular Matrix Production by Osteoblasts
Globus, Ruth; [2003]; 2 pp.; In English; Mechanical Engineering Course, 17 Apr. 2003, Stanford, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

In this graduate course lecture, the basic biology of osteoblasts will be explored. Cells of the osteoblast lineage arise from the mesoderm and neural crest, showing remarkable plasticity with respect to differentiation. Basic mechanisms involved in

the proliferation, differentiation, and survival of osteoblasts will be described. The extracellular matrix (ECM) is known to be both thc main product of the mature osteoblast, and an effective regulator of osteoblast function. The impact of these interactions on skeletal biology will be discussed.
Author
Osteoblasts; Lectures; Matrices

20030065983 NASA Ames Research Center, Moffett Field, CA, USA
Evaluation of NASA Foodbars as a Standard Diet for Use in Short-Term Rodent Space Flight Studies
Tou, Janet; Grindeland, Richard; Barrett, Joyce; Dalton, Bonnie; Mandel, Adrian; Wade, Charles; [2003]; 39 pp.; In English
Contract(s)/Grant(s): 121-10-30; 121-10-40; 121-10-50; No Copyright; Avail: CASI; A03, Hardcopy

A standard rodent diet for space flight must meet the unique conditions imposed by the space environment and must be nutritionally adequate since diet can influence the outcome of experiments. This paper evaluates the use of National Aeronautics and Space Administration (NASA) developed Foodbars as a standard space flight diet for rats. The Foodbar's semi-purified formulation permits criteria such as nutrient consistency, high nutrient bioavailability and flexibility of formulation to be met. Extrusion of the semi-purified diet produces Foodbars with the proper texture and a non-crumbing solid form for use in space. Treatment of Foodbar with 0.1% potassium sorbate prevents mold growth. Irradiation (15-25 kGy) prevents bacterial growth and in combination with sorbate-treatment provides added protection against mold for shelf-stability. However, during the development process, nutrient analyses indicated that extrusion and irradiation produced nutrient losses. Nutrients were adjusted accordingly to compensate for processing losses. Nutrient analysis of Foodbars continues to be performed routinely to monitor nutrient levels. It is important that the standard rodent diet provide nutrients that will prevent deficiency but also avoid excess that may mask physiological changes produced by space flight. All vitamins levels in the Foodbars, except for vitamin K conformed to or exceeded the current NRC (1995) recommendations. All indispensable amino acids in Foodbar conformed to or exceeded the NRC nutrient recommendation for mice growth and rat maintenance. However, some indispensable amino acids were slightly below recommendations for rat reproduction/growth. Short-term (18-20 d) animal feeding studies indicated that Foodbars were palatable, supported growth and maintained health in rats. Results indicated that NASA rodent Foodbars meet both the physical and nutritional criteria required to support rodents in the space environment and thus, may be used successfully as a standard diet for short-term space flight studies. However, nutritional adequacy of NASA Rodent Foodbars as a standard diet on longer duration (>20 d) space flight missions remains to be determined.
Author
Nutrition; Rodents; Consumables (Spacecrew Supplies); Diets; Space Flight Feeding

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*.

20030065739 Army Research Inst. of Environmental Medicine, Natick, MA
Heat Strain Imposed by Toxic Agent Protective Systems
Cadarette, B. S.; Levine, L.; Staab, J. E.; Kolka, M. A.; Correa, M.; Aug. 2000; 7 pp.; In English
Report No.(s): AD-A414227; USARIEM-M99-49; No Copyright; Avail: CASI; A02, Hardcopy

This study evaluated physiological heat strain from two developmental toxic agent protective systems compared to the standard Toxicological Agent Protective (TAP) suit during exercise-heat stress. Eight subjects (six men, two women) completed three experimental trials, at 38C, 30% rh, wearing: 1) Self Contained Toxic Environment Protective Outfit (STEPO) with rebreather (STEPO-R); 2) STEPO with tether (STEPO-T) or 3) the standard TAP. The STEPO systems provided effective body cooling of,; STEPO-R, 200 +/-36 W; and STEPO-T, 186 +/-59 W. TAP had no cooling. All experimental trials used treadmill walking at 0.89 m'sec-1, 0% grade at exercise/rest cycles of 20/10 min for 240 min. Metabolic rates for the treatments were: STEPO-R, 298 +/-26 W; STEPO-T, 299 +/-34 W; and TAP, 222 +/-40 W. Rate of heat storage was less ($p<0.05$) in STEPO-R (37 +/-8 W'm-2) and STEPO-T (38 +/-12 W'm-2) than in TAP (77 +/-15 W'm-2). Sweating rate was less ($p<0.05$) in STEPO-T (10.0 /- 4.8 g'min-1) than in TAP (23.8 +/-11.4 g'min-1). There was no difference between STEPO-R (12.3 +/-5.6 g'min-1) and the other two uniform systems. Subjects did not complete targeted exposure times of 240 minutes. Exposure time was longer ($p<0.05$) in STEPO-R (83 +/-22 min) and STEPO-T (106 +/-39 min) than in TAP (46 +/-10

min). Predicted time to 39.0C was less (p<0.O5) in TAP (69 +/-20 min) than in either STEPO-R (226 +/-124 min or STEPO-T (244 +/-170 min). The results of this study show that cooling in STEPO significantly reduced heat storage relative to TAP. The new generation toxic cleanup uniform systems effectively reduced heat stress and increased work capabilities compared to the standard TAP suit.
DTIC
Heat Tolerance; Toxicology; Physical Exercise; Physiology

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*.

20030065682 Massachusetts Inst. of Tech., Cambridge, MA
Disturbances of Higher Level Neural Control-Robotic Applications in Stroke
Krebs, H. I.; Volpe, B. T.; Palazzolo, J.; Fasoli, S.; Ferraro, M.; Oct. 25, 2001; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A411543; No Copyright; Avail: CASI; A02, Hardcopy

We review results of initial clinical trials with 76 stroke patients at the Burke Rehabilitation Hospital. They provide evidence that robot-aided training enhances recovery. We also discuss technology under development, including algorithms for evaluating patients' performance. To conclude, we summarize different modalities of robot-aided therapy. In our initial clinical trials we used a single modality of robot therapy, but since each lesion is unique there is no reason to believe that a 'one-size-fits-all' optimal treatment exists. We argue that therapy should be tailored to each patient's needs.
DTIC
Robotics; Therapy; Robots; Cerebral Vascular Accidents; Patients

20030065890 NASA Marshall Space Flight Center, Huntsville, AL, USA
Status of the Node 3 Regenerative Environmental Cpntrol& Life Support System Water Recovery & Oxygen Generation Systems
Carrasquillo, Robyn L.; January 2003; 12 pp.; In English; 33rd International Conference on Environmental Conference on Environmental Systems, 7-11 Jul. 2003, Vancouver, British Columbia, Canada
Report No.(s): Rept-2003-01-2590; Copyright; Avail: CASI; A03, Hardcopy

NASA s Marshall Space Flight Center is providing three racks containing regenerative water recovery and oxygen generation systems (WRS and OGS) for flight on the lnternational Space Station s (ISS) Node 3 element. The major assemblies included in these racks are the Water Processor Assembly (WPA), Urine Processor Assembly (UPA), Oxygen Generation Assembly (OGA), and the Power Supply Module (PSM) supporting the OGA. The WPA and OGA are provided by Hamilton Sundstrand Space Systems lnternational (HSSSI), while the UPA and PSM are being designed and manufactured in-house by MSFC. The assemblies are currently in the manufacturing and test phase and are to be completed and integrated into flight racks this year. This paper gives an overview of the technologies and system designs, technical challenges encountered and solved, and the current status.
Author
Life Support Systems; Oxygen Production; Water Reclamation; Waste Treatment; International Space Station

20030065905 NASA Marshall Space Flight Center, Huntsville, AL, USA
Operational Experience with the Internal Thermal Control System Dual-Membrane Gas Trap
Leimkuehler, Thomas O.; Lukens, Clark; Reeves, Daniel R.; Holt, James M.; [2003]; 12 pp.; In English; 2003 International Conference on Environmental Systems 33rd Annual Meeting, 7-10 Jul. 2003, Vancouver, British Columbia, Canada
Report No.(s): SAE-2003-01-2565; Copyright; Avail: Other Sources

A dual-membrane gas trap is currently used to remove non-condensed gases (NCG) from the Internal Thermal Control System (ITCS) coolant on board the International Space Station. The gas trap consists of concentric tube membrane pairs, comprised of outer hydrophilic tubes and inner hydrophobic fibers. Liquid coolant passes through the outer hydrophilic membrane, which traps the NCG. The inner hydrophobic fiber allows the trapped NCG to pass through and vent to the ambient atmosphere in the cabin. The purpose of the gas trap is to prevent gas bubbles from causing depriming, overspeed, and shutdown of the ITCS pump, and the current gas trap has performed flawlessly in this regard. However, because of actual

operational conditions on-orbit, its gas removal performance and operational lifetime have been affected. This paper discusses experiences with several of these dual- membrane gas traps, including on-orbit gas venting rate, effects due to the presence of nickel in the ITCS coolant, and subsequent refurbishing to remove the nickel from the gas trap.
Author
International Space Station; Temperature Control; Traps

20030065941 NASA Marshall Space Flight Center, Huntsville, AL, USA
International Space Station Bacteria Filter Element Post-flight Testing and Service Life Prediction
Perry, J. L.; Jouanne, R. G.; Turner, E. H.; [2003]; 5 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada; Original contains black and white illustrations
Report No.(s): Rept-2003-01-2490; Copyright; Avail: Other Sources

The International Space Station uses high efficiency particulate air (HEPA) filters to remove particulate matter from the cabin atmosphere. Known as Bacteria Filter Elements (BFEs), there are 13 elements deployed on board the ISS's U.S. Segment. The pre-flight service life prediction of 1 year for the BFEs is based upon performance engineering analysis of data collected during developmental testing that used a synthetic dust challenge. While this challenge is considered reasonable and conservative from a design perspective, an understanding of the actual filter loading is required to best manage the critical ISS Program resources. Thus testing was conducted on BFEs returned from the ISS to refine the service life prediction. Results from this testing and implications to ISS resource management are discussed. Recommendations for realizing significant savings to the ISS Program are presented.
Author
International Space Station; Air Filters; Particulates; Reliability Analysis; Service Life

20030065981 NASA Marshall Space Flight Center, Huntsville, AL, USA
Octafluoropropane Concentration Dynamics On Board the International Space Station
Perry, J. L.; [2003]; 6 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada
Report No.(s): SAE-2003-01-2651; Copyright; Avail: CASI; A02, Hardcopy

Since activating the International Space Station s (IS9 Service Module in November 2000, archival air quality samples have shown highly variable concentrations of octafluoropropane in the cabin. This variability has been directly linked to leakage from air conditioning systems on board the Service Module, Zvezda. While octafluoro- propane is not highly toxic, it presents a significant chal- lenge to the trace contaminant control systems. A discussion of octafluoropropane concentration dynamics is presented and the ability of on board trace contami- nant control systems to effectively remove octafluoropro- pane from the cabin atmosphere is assessed. Consideration is given to operational and logistics issues that may arise from octafluoropropane and other halo- carbon challenges to the contamination control systems as well as the potential for effecting cabin air quality.
Author
International Space Station; Service Modules; Air Quality; Fluorine Organic Compounds

20030065986 NASA Marshall Space Flight Center, Huntsville, AL, USA
Post-Flight Sampling and Loading Characterization of Trace Contaminant Control Subassembly Charcoal
Perry, J. L.; Cole, H. E.; Cramblitt, E. L.; El-Lessy, H. N.; Manuel, S.; Tucker, C. D.; [2003]; 10 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, BC, Canada
Report No.(s): AIAA Paper 2003-01-2487; Copyright; Avail: CASI; A02, Hardcopy

Trace chemical contaminants produced by equipment offgassing and human metabolic processes are removed from the atmosphere of the International Space Station s U.S. Segment by a trace contaminant control subassembly (TCCS). The TCCS employs a combination of physical adsorption, thermal catalytic oxidation, and chemical adsorption processes to accomplish its task. A large bed of granular activated charcoal is a primary component of the TCCS. The charcoal contained in this bed, known as the charcoal bed assembly (CBA), is expendable and must be replaced periodically. Pre-flight engineering analyses based upon TCCS performance testing results established a service life estimate of 1 year. After nearly 1 year of cumulative in-flight operations, the first CBA was returned for refurbishment. Charcoal samples were collected and analyzed for loading to determine the best estimate for the CBAs service life. A history of in-flight TCCS operations is presented as well as a discussion of the charcoal sampling procedures and chemical analysis results. A projected service life derived from the

observed charcoal loading is provided. Recommendations for better managing TCCS resources are presented.
Author
Charcoal; Service Life; Air Purification; Body Fluids; International Space Station

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EXOBIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

20030066083 Universite de Bretagne Occidentale, Brest, France
Metabolic Signatures for Life Detection on Europa
Prieur, Daniel; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 62; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

In this review, a variety of compounds resulting from oxido-reduction, fermentation or photosynthetic reactions carried out by terrestrial Prokaryotes will be presented as potential metabolic signatures for life detection.
Derived from text
Europa; Metabolism; Extraterrestrial Life; Detection

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*.

20030065614 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Explicit Building-Block Multiobjective Genetic Algorithms: Theory, Analysis, and Development
Zydallis, Jesse B.; Mar. 2003; 391 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412871; AFIT/DS/ENG/03-01; No Copyright; Avail: CASI; A17, Hardcopy

This dissertation research emphasizes explicit Building Block (BB) based MO EAs performance and detailed symbolic representation. An explicit BB-based MOEA for solving constrained and real-world MOPs is developed the Multiobjective Messy Genetic Algorithm II (MOMGA-II) which is designed to validate symbolic BB concepts. The MOMGA-II demonstrates that explicit BB-based MOEAs provide insight into solving difficult MOPs that is generally not realized through the use of implicit BB-based MOEA approaches. This insight is necessary to increase the effectiveness of all MOEA approaches. In order to increase MOEA computational efficiency parallelization of MOEAs is addressed. Communications between processors in a parallel MOEA implementation is extremely important, hence innovative migration and replacement schemes for use in parallel MOEAs are detailed and tested. These parallel concepts support the development of the first explicit BB-based parallel MOEA the pMOMGA-II. MOEA theory is also advanced through the derivation of the first MOEA population sizing theory. The multiobjective population sizing theory presented derives the MOEA population size necessary in order to achieve good results within a specified level of confidence. Just as in the single objective approach the MOEA population sizing theory presents a very conservative sizing estimate. Validated results illustrate insight into building block phenomena good efficiency excellent effectiveness and motivation for future research in the area of explicit BB-based MOEAs. Thus the generic results of this research effort have applicability that aid in solving many different MOPs.
DTIC
Genetic Algorithms; Computation

20030065912 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
On the Theory of Thin Shallow Shells
Nazarov, A. A.; Prikladnaia Matematika i Mekhanika; December 1956; Volume 13, pp. 547-550; In English
Report No.(s): NACA-TM-1426; No Copyright; Avail: CASI; A02, Hardcopy

This report is concerned with the theory of thin shallow shells. It does not employ the lines of curvature as the coordinate

system, but employs 'almost cartesian coordinates' or the coordinates obtained by cutting the surface into two mutually orthogonal systems of parallel planes.
CASI
Thin Walled Shells; Cartesian Coordinates

20030065916 National Advisory Committee for Aeronautics, Washington, DC, USA
On the Theory of Anisotropic Shallow Shells
Ambartsumyan, S. A.; December 1956; 12 pp.; In English
Report No.(s): NACA-TM-1424; No Copyright; Avail: CASI; A03, Hardcopy
A numerical analysis of thin-walled shallow shells is presented. Equations of equilibrium and relations between deformations and stresses are included along with fundamental differential equations.
CASI
Anisotropic Shells; Numerical Analysis; Shallow Shells

20030065948 Defence Science and Technology Organisation, Edinburgh, Australia
Estimation of Maneuvering Targets using Hybrid Filters
Ford, Jason J.; Hunter, Peter G.; April 2003; 47 pp.; In English
Report No.(s): DSTO-TN-0488; DODA-AR-012-723; Copyright; Avail: Other Sources
This report examines the problem of estimating the location, velocity and manoeuvre of a manoeuvring target (from range, bearing and pose information). The report considers a non-linear modeling technique in which the target is represented as a hybrid system (a combination of discrete and continuous valued states) and considers new associated approaches such as the polymorphic estimator. Although simulation studies were performed, the polymorphic estimator had serious numeric problems that suggested the estimator should not be used until the approach is refined. This report is intended to facilitate further discussion and development of the approach (if deemed necessary); hence, it includes details of the assumptions made and the MatlabTM implementation.
Author
Nonlinear Systems; Mathematical Models; Target Acquisition; Maneuverability; Nonlinear Filters

20030066109 NASA Ames Research Center, Moffett Field, CA, USA
Evolvable Systems for Space Applications
Lohn, Jason; Crawford, James; Globus, Al; Hornby, Gregory; Kraus, William; Larchev, Gregory; Pryor, Anna; Srivastava, Deepak; [2003]; 8 pp.; In English; 2003 Space Mission Challenges for Information Technology, 13-16 Jul. 2003, Pasadena, CA, USA; Copyright; Avail: CASI; A02, Hardcopy
This article surveys the research of the Evolvable System Group at NASA Ames Research Center. Over the past few years, our group has developed the ability to use evolutionary algorithms in a variety of NASA applications ranging from spacecraft antenna design, fault tolerance for programmable logic chips, atomic force field parameter fitting, analog circuit design, and earth observing satellite scheduling. In some of these applications, evolutionary algorithms match or improve on human performance.
Author
Algorithms; Technology Utilization; Spacecraft Antennas

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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.

20030065602 Cornell Univ., Ithaca, NY
Monte Carlo Simulation of Radiation in Hypersonic Flows
Boyd, Lain D.; Sep. 2002; 12 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0500
Report No.(s): AD-A414031; ARO-38283.1-EG-SD1; No Copyright; Avail: CASI; A03, Hardcopy
Radiation is generated in hypersonic flows of missiles. Depending on the flight altitude, the gas dynamics may be modeled by continuum or kinetic simulation techniques At high altitude, kinetic methods are more physically accurate, but continuum

methods are more numerically efficient. In an attempt to utilize the best of both approaches, we are undertaking the development of a hybrid continuum-kinetic method for high altitude hypersonic flows. Ultimately, such a method will provide the ability to obtain physically accurate and numerically efficient predictions of the radiation generated by hypersonic missiles The development of this hybrid method involves two important steps: (1) determination in a flow field of when to switch between the continuum and kinetic methods (a so-called continuum breakdown parameter); and (2) smooth and physically accurate communication of data between the continuum and kinetic methods. This report describes a first version of such a hybrid code that is applied to a hypersonic flow over a two-dimensional wedge. The preliminary results are encouraging although they also point to areas where the method requires improvement.
DTIC
Hypersonic Flow; Monte Carlo Method; Radiation; Missiles; Mathematical Models

20030065635 General Electric Co., Niskayuna, NY, USA
Imperishable Networks: Complexity Theory and Communication Networking-Bridging the Gap Between Algorithmic Information Theory and Communication Networking
Bush, Stephen F.; Evans, Scott; Kilkarnni, Amit B.; Apr. 2003; 155 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-01-C-0182; DARPA ORDER-AOM100; Proj-FTNP
Report No.(s): AD-A413981; AFRL-IF-RS-TR-2003-83; No Copyright; Avail: CASI; A08, Hardcopy

The most significant result from this project has been experimental validation that complexity plays a critical role in information assurance and can be broadly applied as the basis for security analysis and fault tolerant network design. Complexity Theory is a large and rapidly evolving science. As progress is made in various topics of Complexity Theory, the individual topics will help to re-enforce each other. Our goal has been to reduce the requirement and dependence upon detailed a priori information about known attacks and detect novel attacks by computing vulnerability and detecting anomalous behavior based upon an inherent, fundamental property of information itself, namely, its complexity and sophistication. Results of complexity measures applied to network protocols, processes, and information have been presented and related to Information Assurance and network fault tolerance. Active networks form an ideal environment in which to study the effects of trade-offs in algorithmic and static information representation because an active packet consists of both code and static data. The code can contain the protocol or a compressed form of the data to be transported. If the code is the protocol, then information about the complexity of the protocol can be gleaned from the active packet code. An active packet that has been reduced to the length of the best estimate of the Kolmogorov Complexity of the information it transmits will be called the minimum size active packet. There are interesting relationships between Kolmogorov Complexity, prediction, compression and the model size used in the Active Virtual Network Management Prediction (AVNMP) mechanism. These relationships are throughout this report.
DTIC
Mathematical Models; Communication Networks; Algorithms; Fault Tolerance; Computer Information Security

20030065643 Texas A&M Univ., College Station, TX, USA
Error Concealment of MPEG-2 AAC Audio Using Modulo Watermarks
Cheng, Samuel; Yu, Heather; Xiong, Zixiang; Jan. 2002; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0509
Report No.(s): AD-A413996; No Copyright; Avail: CASI; A01, Hardcopy

We propose an error concealment scheme for MPEG-2 compressed (AAC) audio using a novel modulo watermarking technique. It can be used on top of other error control schemes. After the modulo watermark is embedded, an MPEG-2 AAC audio only shows negligible file size increase and moderate SNR penalty. For audio transmission over packet-switch networks (e.g., the Internet), using our watermark-based concealment scheme shows consistent SNR gain over using conventional concealment schemes.
DTIC
Audio Frequencies; Sound Transmission; Error Detection Codes; Computer Programming

20030065646 Army War Coll., Carlisle Barracks, PA
A New Strategy for Leveraging Current and Future Simulation Technologies for the U.S. Army
Stone, George F., III; Apr. 7, 2003; 32 pp.; In English
Report No.(s): AD-A414061; No Copyright; Avail: CASI; A03, Hardcopy

The fundamental problem with simulations today is the inability of modeling and architecture processes to be dynamic

and flexible. Due to budget constraints exacerbated by multiple requirements in an always-changing international crisis-laden world, the U.S. Army needs a new strategy to leverage simulations and modeling for research, analysis, acquisition, experimentation and training. Current issues in modeling and simulation across the Department of Defense, U.S. Army and industry need resolution for future strategic policies and practice. Areas of focus in this paper are modeling and simulation trends, uses, education and information technology. To prepare for the future, a new and ambitious effort must revamp current simulation development processes utilizing in-house‘ military expertise for requirements definition, conceptual modeling and project supervision. The military simulation development team will consider Extreme Programming and Advanced Engineering Environment principles to build a simulation program prototype that becomes the basis for awarding coding only’ contracts. This paper outlines an iterative, dynamic and revolutionary strategy for simulation-related technology utilization, both present and future, with application geared towards the effectiveness and efficiency of future simulation programs.
DTIC
Computerized Simulation; Software Engineering; Technology Utilization; Armed Forces (United States); Mathematical Models

20030065654 Princeton Univ., NJ, USA
Content Analysis of Video Sequences
Orchard, Michael; Joyce, Robert; Feb. 2002; 4 pp.; In English
Contract(s)/Grant(s): DAAG55-97-1-0208
Report No.(s): AD-A414069; No Copyright; Avail: CASI; A01, Hardcopy

Content analysis of video sequences is a critical component of virtually any application involving the management of large video data sets. Systems for managing video databases or transmitting large numbers of video sequences are most efficient if they incorporate some understanding of the video content. The required analysis must be automated if large volumes of video are to be accommodated. This report presents two contributions of this project to problems in video content analysis. The first is an algorithm for fast estimation of scene boundaries in video sequences. The second is an approach for using video content and short-term traffic statistics to improve bandwidth allocation when transmitting video over the internet.
DTIC
Image Processing; Sequencing; Video Compression; Video Data

20030065671 Oregon Graduate Inst. of Science and Technology, Beaverton, OR, USA
Multimodal Interaction for Virtual Environments
Cohen, Philip R.; Jan. 1999; 19 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0380
Report No.(s): AD-A413862; No Copyright; Avail: CASI; A03, Hardcopy

We describe an approach to natural 3D multimodal interaction in immersive environments. Our approach fuses symbolic and statistical information from a set of 3D gesture and speech agents building in part on prior research on disambiguating the user’s intent in 2D and 2.5D user interfaces. We present an experimental system architecture that embodies this approach, and provide examples from a preliminary 3D multimodal testbed to explore our ideas in augmented and virtual reality
DTIC
Virtual Reality; Computerized Simulation

20030065693 Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA
The Effectiveness of Web-Based Instruction
Wisher, Robert A.; Olson, Tatana M.; Jan. 2003; 34 pp.; In English
Report No.(s): AD-A413462; ARI-RR-1802; No Copyright; Avail: CASI; A03, Hardcopy

As the Army focuses more on Web-based instruction as a delivery option for training, professional development, and education, it is important to understand its instructional effectiveness. A search of the literature between 1996 and 2002 identified more than 500 reports concerning Web-based courses, that is courses delivered over the Internet or an intranet and conveyed through a browser. Most concerned recommendations for design or technology issues rather than empirical measures of learning outcomes. From this larger set, 47 studies reported empirical measures of outcomes; of these, 15 studies reported data with sufficient detail to compute an effect size. The effect size, comparing Web-based instruction to conventional classroom instruction, was .24, which means the ‘average’ student moved from the 50th to the 59th percentile. In earlier analyses of the effectiveness of other forms of computer-based instruction, effects sizes of between .32 and .41 have been reported (corresponding to the 63rd and 66th percentiles). In terms of instructional effectiveness, it appears that current

practices in Web-based instruction improve learning when compared to the classroom, but many more complete studies are needed before the full effect size is understood.
DTIC
World Wide Web; Computer Assisted Instruction; Education; Computer Networks

20030065725 Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA
Utility of Game Instructions
Chen, Jessie Y.; Apr. 2003; 44 pp.; In English
Contract(s)/Grant(s): Proj-2O262785A790
Report No.(s): AD-A414105; ARI-TR-1135; No Copyright; Avail: CASI; A03, Hardcopy

Due to the increasing usage of computer games for military training purposes, it is more important than ever to understand how computer games can be utilized in an effective and efficient manner. One important issue facing the military training community is that training time is at a premium and trainees need to be able to play the game within as short a time as possible so they can start using the game to train the skills of interest. This report describes an experiment that examined various game-related performance measures and concluded that the two different instructional techniques (i.e. , computer-based tutorials and game tips) appeared to be effective in different ways, and players with access to both learned the game most effectively. To be more specific, computer-based tutorials appeared to be more beneficial for motor elements such as maneuvering and actions. On the other hand, those who had access to game tips performed better in cognitive segments of the game such as setting up game plans and familiarity with the game interface. These results can be incorporated in military training programs where computer games are part of the curriculum. Future military game development can also utilize these results to determine which type of instructional material to be included in the games.
DTIC
Education; Computer Assisted Instruction; Armed Forces (United States); Computers

20030065987 NASA Ames Research Center, Moffett Field, CA, USA
Support of Multidimensional Parallelism in the OpenMP Programming Model
Jin, Hao-Qiang; Jost, Gabriele; [2003]; 14 pp.; In English; International Workshop on OpenMP: Experiences and Implementation, Oct. 2003, Tokyo, Japan
Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D; RTOP 704-42-42; No Copyright; Avail: CASI; A03, Hardcopy

OpenMP is the current standard for shared-memory programming. While providing ease of parallel programming, the OpenMP programming model also has limitations which often effect the scalability of applications. Examples for these limitations are work distribution and point-to-point synchronization among threads. We propose extensions to the OpenMP programming model which allow the user to easily distribute the work in multiple dimensions and synchronize the workflow among the threads. The proposed extensions include four new constructs and the associated runtime library. They do not require changes to the source code and can be implemented based on the existing OpenMP standard. We illustrate the concept in a prototype translator and test with benchmark codes and a cloud modeling code.
Author
Parallel Programming; Standards

20030065988 NASA Ames Research Center, Moffett Field, CA, USA
Certification Processes for Safety-Critical and Mission-Critical Aerospace Software
Nelson, Stacy; June 30, 2003; 30 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This document is a quick reference guide with an overview of the processes required to certify safety-critical and mission-critical flight software at selected NASA centers and the FAA. Researchers and software developers can use this guide to jumpstart their understanding of how to get new or enhanced software onboard an aircraft or spacecraft. The introduction contains aerospace industry definitions of safety and safety-critical software, as well as, the current rationale for certification of safety-critical software. The Standards for Safety-Critical Aerospace Software section lists and describes current standards including NASA standards and RTCA DO-178B. The Mission-Critical versus Safety-Critical software section explains the difference between two important classes of software: safety-critical software involving the potential for loss of life due to software failure and mission-critical software involving the potential for aborting a mission due to software failure. The DO-178B Safety-critical Certification Requirements section describes special processes and methods required to obtain a safety-critical certification for aerospace software flying on vehicles under auspices of the FAA. The final two sections give

an overview of the certification process used at Dryden Flight Research Center and the approval process at the Jet Propulsion Lab (JPL).
Author
Aerospace Safety; Computer Programs; Certification

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.

20030065604 Maryland Univ., Baltimore, MD
Engineering a Distributed Intrusion Tolerant Database System
Liu, Peng; Mar. 2003; 28 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-00-2-0575; DARPA ORDER-K445; Proj-K445
Report No.(s): AD-A412970; AFRL-IF-RS-TR-2003-52; No Copyright; Avail: CASI; A03, Hardcopy

The primary accomplishment of this project is a new paradigm for secure database system design, intrusion tolerant database systems. In particular, an innovative intrusion tolerant database system framework, denoted ITDB, is developed. While traditional secure database systems rely on preventive controls, ITDB can detect intrusions, isolate attacks, contain, assess and repair the damage caused by intrusions in a timely manner such that a self-stabilized level of data integrity and availability can be provided to applications. Built on top of COTS DBMS, ITDB arms commercial database servers with the ability to deliver sustained valid data access services even in the face of intensive attacks. To validate ITDB, a prototype ITDB system is designed and implemented. The prototype is a seamless integration of five major subsystems, namely the Malicious Transaction Detection subsystem, the Attack Recovery subsystem, the Attack Isolation subsystem, the Damage Containment subsystem, and the Self-Stabilization subsystem. Extensive evaluation of the prototype based on practical database applications, simulated workload and injected attacks is done. Preliminary testing measurements suggest that when the accuracy of the intrusion detector is satisfactory, ITDB can effectively tolerate database intrusions with reasonable performance penalty.
DTIC
Data Bases; Systems Engineering; Computer Viruses; Computer Systems Programs

20030065619 SRI International Corp., Menlo Park, CA
Survivable Loosely Coupled Architectures
Rushby, John; Song, Dawn X.; Millen, Jonathan K.; Rueb, Harald; Cortier, Veronique; Mar. 2003; 131 pp.; In English
Contract(s)/Grant(s): F30602-96-C-0291; Proj-D985
Report No.(s): AD-A412984; AFRL-IF-RS-TR-2003-63; No Copyright; Avail: CASI; A07, Hardcopy

The objective of this research was to develop mechanisms and methods of analysis to support construction of survivable systems where survivable means systems able to withstand multiple kinds of faults among their components, including those induced deliberately by an active attacker. One class of architectures for survivability builds on classical methods for fault tolerance, in which replication and voting are used to mask faults. An alternative class of methods requires less tight coordination, giving rise to loosely coupled architectures. Mechanisms that support survivability in loosely coupled architectures are typically based on cryptography, and much of the work performed in this project focused on development of suitable cryptographic protocols and on their formal verification. In the course of the project, the state of the art was advanced from one where formal verification of these protocols was a tour de force to one where it may be considered routine and available for general deployment. The outputs of this research are documented in a series of technical papers (with associated abstracts) that follow.
DTIC
Fault Tolerance; Program Verification (Computers)

20030065653 Army Research Lab., Aberdeen Proving Ground, MD
The U.S. Army Research Laboratory Dynamic Terrain Server
Thomas, Mark A.; Apr. 2003; 22 pp.; In English
Report No.(s): AD-A413857; ARL-TR-2962; No Copyright; Avail: CASI; A03, Hardcopy

The U.S. Army Research Laboratory (ARL) is conducting research in methods to compute and distribute dynamic terrain

information in real-time distributed simulation. The purpose is to populate virtual environments with real-world dynamic terrain and objects such as rubble and debris, dings, and breaches of structures. Dismounted infantry simulation requires these obstacles and capabilities for room-clearing operations, urban terrain warfare, and situational awareness. The ARL Dynamic Terrain Server (DTServer) provides this capability. The DTServer computes effects on structures from munitions detonations and collisions. The server transmits the results to client simulations on the network and updates the status of rubble entities. The result of using the DTServer is a unified terrain database across all simulators ensuring fair-fight, realism, and training effectiveness. This report will describe the DTServer capabilities, architecture, and run-time considerations.
DTIC
Real Time Operation; Computerized Simulation

20030065716 California Univ., San Diego, La Jolla, CA
Nonlinear Spatio-Temporal Processing for Ultrahigh Bandwidth Communication
Fainman, Y.; Apr. 2000; 23 pp.; In English
Contract(s)/Grant(s): F49620-98-1-0402; Proj-3484
Report No.(s): AD-A413211; AFRL-SR-AR-TR-03-0115; No Copyright; Avail: CASI; A03, Hardcopy

This research project is currently supported in part by the NSF, ARPA-OTC II and AFOSR. We are extending the research on artificial dielectrics to nonlinear optical composites which have been recently proposed to BMDO and AFOSR. The instrumentation and equipment requested will enable basic research on nonlinear optics of ultrashort pulses for ultrahigh bandwidth (e.g., over 1 Tbits/sec) communication applications. In particular, this novel approach will investigate devices and optical network systems for enhanced information transmission rate, network controllability and reliability, network security using quantum and classical cryptography. The requested equipment will be used to investigate the effects of the fiber optic and/or free space communication channel on the signal fidelity, linear and nonlinear dispersion, and the effects of fiber optic amplifiers. This equipment will also enhance experimental work on implementation of multidimensional optical channel using ultrashort pulse nonlinear spectral holography, and design and fabrication of nonlinear artificial dielectric materials that utilize near field effects to increase their efficiency. In addition, the equipment requested will significantly enhance the overall characterization and processing capability within the Department of Electrical and Computer Engineering at UCSD. Graduate and undergraduate students will benefit from access to this fabrication and characterization equipment.
DTIC
Signal Processing; Nonlinear Optics; Bandwidth; Computer Networks; Space Communication

20030065719 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
A System Dynamics Approach for Information Technology Implementation and Sustainment
Fonnesbeck, Nathan W.; Mar. 2003; 336 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413443; AFIT/GEE/ENV/03-08; No Copyright; Avail: CASI; A15, Hardcopy

The goal of this research is to bring a new, dynamic modeling perspective to organizational information technology (IT) implementation systems (using the Air Force GeoBase initiative as a real-world example) without compromising principles from the research literature. Undesired behavior patterns, from historically poor IT implementation performance, versus desired behavior patterns are incorporated into the model structure. Using a system dynamics approach, multiple simulation runs under various initial conditions and organizational contexts are performed and compared over a short-term versus a long-term period of time. Based on these simulation ruins, various mixes of management interventions, under varying conditions, are recommended to improve IT implementation performance based on manager and organizational goals.
DTIC
Information Systems; Dynamic Models; Technology Utilization; Computer Systems Simulation; Simulation

20030065721 California Univ., Los Angeles, CA
Design and Analysis of Mobile Backbone Networks
Rubin, Izhak; Aug. 31, 2002; 18 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0338
Report No.(s): AD-A414071; ARO-37637-CI; No Copyright; Avail: CASI; A03, Hardcopy

The authors have been investigating the design of next-generation mobile wireless networks that employ no existing infrastructure to aid the communications process. They have new mechanisms for providing such networking services and for configuring (ad hoc) wireless network systems through their innovative development of the Mobile Backbone Network (MBN) concept. Their network architecture resembles that of a cellular network system in that they employ Backbone Nodes (BNs)

that have similar functionality to that provided by base stations for cellular wireless networks. Backbone Capable Nodes (BCNs) are automatically selected to act as BNs based upon their location, radio communications reach, and communications and processing capacities. Using the BNs, backbone networks (BNets) automatically self-configure under unit movements and adapt to changes in communications conditions. Unmanned ground vehicles (UGVs) are guided to desirable locations to serve as BNs in areas that require communications access support. A backbone node is used to manage its access network (ANet). The latter serves to provide access to the network of regular nodes or of gateway nodes. The authors also have been developing the following: techniques for the topological synthesis of mobile backbone networks; new methods (identified as MPLS+) for effective networking and routing of messages across BNets when the processes implemented by the nodal routers must be simplified due to their capacity, size, and power constraints; and developing new medium access control (MAC) algorithms for access networks feeding their MBN architectures. In addition, the authors have been evaluating and synthesizing such networks under the loading of highly bursty traffic processes, modeled as multifractal stochastic processes. These networks serve as key architectures for the design and operation of next-generation military network systems.
DTIC
Design Analysis; Communication Networks; Wireless Communication; Architecture (Computers); Algorithms

20030065785 RAND Europe, Delft, Netherlands
Enabling the Information Society by Stimulating the Creation of a Broadband Environment in Europe. Analyses of Evolution Scenarios for Future Networking Technologies and Networks in Europe
Botterman, Maarten; Anderson, Robert H.; van Binst, Paul; Cave, Jonathan; Libicki, Martin; Jan. 2003; 104 pp.; In English
Report No.(s): AD-A413933; RAND/MR-1579-EC; No Copyright; Avail: CASI; A06, Hardcopy

How can Europe become, the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion‘? Central to this goal are networks and networking: not only telecommunications but also information technology writ large. Their capability and performance are crucial for creating a globally competitive environment. Accordingly, the European Commission’s eEurope Action Plan focuses on investing in a cheaper, faster, and more secure Internet. Increased competition is seen as a crucial step in the way forward to achieve cheaper Internet access and higher bandwidth capacity. This report is the result of a study commissioned by the Directorate General Information Society of the European Commission to create a better understanding of the pace and direction of developments in this area, mapped against an uncertain future, and to recommend policy options for government intervention as a background against which political decision making can take place. The study provides an analysis of the development of electronic networks in Europe and North America and its technical, economic and political drivers. It includes four scenarios depicting possible futures of electronic networks in Europe, a framework for policy formulation, analyses of selected current policies and observations regarding possible policy measures and the input of experts and stakeholders in the field during a workshop in Brussels, and concludes with a series of observations and recommendations for policy action and further research.
DTIC
Europe; Networks; Broadband

20030065942 NASA Ames Research Center, Moffett Field, CA, USA
Roles for Agent Assistants in Field Science: Understanding Personal Projects and Collaboration
Clancey, William J.; April 1, 2003; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A human-centered approach to computer systems design involves reframing analysis in terms of the people interacting with each other. The primary concern is not how people can interact with computers, but how shall we design work systems (facilities, tools, roles, and procedures) to help people pursue their personal projects, as they work independently and collaboratively? Two case studies provide empirical requirements. First, an analysis of astronaut interactions with CapCom on Earth during one traverse of Apollo 17 shows what kind of information was conveyed and what might be automated today. A variety of agent and robotic technologies are proposed that deal with recurrent problems in communication and coordination during the analyzed traverse. Second, an analysis of biologists and a geologist working at Haughton Crater in the High Canadian Arctic reveals how work interactions between people involve independent personal projects, sensitively coordinated for mutual benefit. In both cases, an agent or robotic system’s role would be to assist people, rather than collaborating, because today’s computer systems lack the identity and purpose that consciousness provides.
Author
Computer Systems Design; User Requirements; Spacecraft Communication; Lunar Communication; Artificial Intelligence; Scientists; Astronauts

20030065950 NASA Marshall Space Flight Center, Huntsville, AL, USA
Case for Deploying Complex Systems Utilizing Commodity Components
Bryant, Barry S.; Pitts, R. Lee; Ritter, George; [2003]; 98 pp.; In English; Grand Systems Architecture Workstation, 4-6 Mar. 2003, Manhattan Beach, CA, USA; Copyright; Avail: CASI; A05, Hardcopy

This viewgraph representation presents a study of the transition of computer networks and software engineering at the Huntsville Operations Support Center (HOSC) from a client/server UNIX based system to a client/server system based on commodity priced and open system components. Topics covered include: an overview of HOSC ground support systems, an analysis for changes to the existing ground support system, an analysis of options considered for the transition to a new system, and a consideration of goals for a new system.
Author
Client Server Systems; Architecture (Computers); Computer Systems Design; Systems Engineering; Ground Support Systems

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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*.

20030065722 California Univ., Berkeley, CA, USA
An Integrated Approach to Intelligent Systems
Sastry, S. S.; Nerode, Anil; Manna, Zohar; Jan. 2002; 39 pp.; In English
Contract(s)/Grant(s): DAAH04-96-1-0341
Report No.(s): AD-A413997; ARO-35873.172-MA-MUR; No Copyright; Avail: CASI; A03, Hardcopy

This report presents a technical summary of the activities of the MURI during the period August 1996 through July 2001. To summarize, the main contributions of the MURI in this period have been to advance the basic state of knowledge in: 1. Multi-modal control of 'single agent' systems: modeling, analysis, control law synthesis and simulation 2. Design of hierarchical control architectures for multi-agent systems that share a single environment 3. Perception systems: (a) hierarchical aggregation (b) wide-area surveillance and (c) low-level perception 4. Frameworks for representing and reasoning with uncertainty Soft computing and evolutionary approaches to the design of complex systems.
DTIC
Artificial Intelligence; Hybrid Structures; Systems Integration; Complex Systems

20030065845 Alabama Univ., Tuscaloosa, AL, USA
An Immunized Aircraft Maneuver Selection System
Karr, Charles L.; July 2003; 38 pp.; In English
Contract(s)/Grant(s): NCC2-1326; No Copyright; Avail: CASI; A03, Hardcopy

The objective of this project, as stated in the original proposal, was to develop an immunized aircraft maneuver selection (IAMS) system. The IAMS system was to be composed of computational and informational building blocks that resemble structures in natural immune systems. The ultimate goal of the project was to develop a software package that could be flight tested on aircraft models. This report describes the work performed in the first year of what was to have been a two year project. This report also describes efforts that would have been made in the final year to have completed the project, had it been continued for the final year. After introductory material is provided in Section 2, the end-of-year-one status of the effort is discussed in Section 3. The remainder of the report provides an accounting of first year efforts. Section 4 provides background information on natural immune systems while Section 5 describes a generic ar&itecture developed for use in the IAMS. Section 6 describes the application of the architecture to a system identification problem. Finally, Section 7 describes steps necessary for completing the project.
Author
Aircraft Models; Applications Programs (Computers); Aircraft Maneuvers; Systems Engineering; Artificial Intelligence; Immune Systems

20030066171 Washington Univ., Saint Louis, MO
Vision for Control: Optimality and Usability
Soatto, Stefano; Jan. 15, 2003; 27 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-1-0139
Report No.(s): AD-A413748; ARO-38929.7-CI; No Copyright; Avail: CASI; A03, Hardcopy

This final report for the grant DAAD19-99-1-0139 and the associated instrumentation grant DURIP 44251-21338 describes research conducted both at Washington University in St. Louis and at the University of California, Los Angeles, from 1999 to 2003. Research has been documented in 34 publications, among which two best-paper awards (the Marr Prize, the highest recognition in the field of Computer Vision, and the Siemens Prize with the Outstanding Paper Award by the IEEE Computer Society) and a book, expected to appear in June 2003. Technology firsts include the first ever system (and still the only one) for estimating three-dimensional structure and motion of an arbitrary (static) scene in real time, and the first optimal algorithms for estimating shape from accommodation.
DTIC
Algorithms; Three Dimensional Motion; Computer Vision

64
NUMERICAL ANALYSIS

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

20030065639 California Inst. of Tech., Pasadena, CA
Multi-Scale Finite Element Approximation for Transport in Heterogeneous Porous Media
Hou, Thomas Y.; Jul. 2002; 9 pp.; In English
Contract(s)/Grant(s): DAAD19-99-1-0141
Report No.(s): AD-A414041; ARO-38540.1-MA; No Copyright; Avail: CASI; A02, Hardcopy

The main objective of this study is to develop an efficient multiscale coarse grid method which can be used as a competitive algorithm in studying composite materials and flow transport in strongly heterogeneous porous media. On one hand, we have explored the possibility of using adaptive mesh to reduce the modeling error introduced by the traditional moment average technique. On the other hand, we found that in the case of high aspect ratio permeability tensor, the modeling error in ignoring high order moments (3rd order or higher) could be very large. To overcome this difficulty, we have investigated an alternative approach that uses two-scale homogenization analysis to derive a coarse grid model in a systematic way. Finally, we have made some progress in developing numerical methods to solve multiscale nonlinear stochastic partial differential equations by using Wiener-Chaos expansions. These methods will reduce the problem of solving stochastic PDEs to solving a set of deterministic PDEs. This numerical method can be combined with our multiscale computational method, and can be used to compute accurately high order statistical quantities more efficiently than the traditional Monte-Carlo method.
DTIC
Finite Element Method; Heterogeneity; Numerical Analysis; Approximation; Algorithms

20030065726 California Univ., Los Angeles, CA
International Conference on Scientific Computing, Partial Differential Equations and Image Processing
Engquist, Bjorn; Sep. 30, 2002; 3 pp.; In English
Contract(s)/Grant(s): F49620-02-1-0095
Report No.(s): AD-A414018; AFRL-SR-AR-TR-03-0184; No Copyright; Avail: CASI; A01, Hardcopy

This is a grant to cover partial cost of the organization of the International Conference on Scientific Computing, Partial Differential Equations and Image Processing held at IPAM, UCLA on Apr 5-7 2002. The Conference was held in honor of Stanley Osher on the occasion of his 60th birthday, to commemorate his achievement in many of the areas covered by this conference, including high resolution shock capturing schemes, level set method, applications to multi-phase flows, computer vision. TV based image restoration, just to name a few.
DTIC
Conferences; Image Processing; Partial Differential Equations; Numerical Analysis

20030065728 Princeton Univ., NJ, USA
Wavelet Domain Image Interpolation via Statistical Estimation
Zhu, Ying; Schwartz, Stuart C.; Orchard, Michael T.; Jan. 2001; 5 pp.; In English; IEEE International Conference on Image Processing 2001
Contract(s)/Grant(s): DAAH04-96-1-0227
Report No.(s): AD-A414065; ARO-35187.4-MA; No Copyright; Avail: CASI; A01, Hardcopy

We propose a new wavelet domain image interpolation scheme based on statistical signal estimation. A linear composite

MMSE estimator is constructed to synthesize the detailed wavelet coefficients as well as to minimize the mean squared error for high-resolution signal recovery. Based on a discrete time edge model we use low-resolution information to characterize local intensity changes and perform resolution enhancement accordingly. A linear MMSE estimator follows to minimize the estimation error. Local image statistics are involved in determining the spatially adaptive optimal estimator. With knowledge of edge behavior and local signal statistics the composite estimation is able to enhance important edges and to maintain the intensity consistency along edges. Strong improvement in both the visual quality and thel PSNRs of the interpolated images has been achieved by the proposed estimation scheme.
DTIC
Interpolation; Mathematical Models; Statistical Analysis; Wavelet Analysis; Image Processing

20030065780 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Deterministic Intracellular Modeling
Young, Jacqueline B.; Mar. 2003; 131 pp.; In English
Report No.(s): AD-A413837; AFIT/GCS/ENC/03M-1; No Copyright; Avail: CASI; A07, Hardcopy

The USA Air Force is interested in the potential side effects at the cellular level from exposure to mission-essential chemicals. Presently, Air Force toxicology studies are conducted to help shed light in identifying potential hazards to workers. However, it takes a considerable amount of money, resources, and time to obtain and analyze experimental results from toxicology studies. The necessity for innovative methods that enable researchers to more effectively generate and analyze data is apparent.
DTIC
Military Technology; Toxic Hazards; Toxicology; Mathematical Models

20030065801 Colorado Univ., Boulder, CO
Developing and Understanding Methods for Large Scale Nonlinear Optimization
Schnabel, Robert B.; Byrd, Richard H.; Dec. 2001; 7 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0176
Report No.(s): AD-A413924; ARO-37302.15-MA; No Copyright; Avail: CASI; A02, Hardcopy

Our main activity in this grant has been the development and testing of techniques for solving global optimization problems for determining the structure of proteins and polymers. The problem is to find the lowest energy configuration of a protein or other polymer. This problem is a global optimization problem because it has a huge number of local minimizers. In addition, locating the lowest (global) minimizer is very difficult. For proteins, the solution of this problem would represent a solution to the well known protein-folding problem.
DTIC
Optimization; Nonlinear Systems; Molecular Structure; Numerical Analysis; Proteins; Folding

20030065817 Texas A&M Univ., College Station, TX, USA
Wavelet-Based Smoothing and Multiplexing of VBR Video Traffic
Ye, Dejian; Xiong, Zixiang; Shao, Huai-Rong; Wu, Qiufeng; Zhu, Wenwu; Jan. 2001; 5 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0509
Report No.(s): AD-A413977; No Copyright; Avail: CASI; A01, Hardcopy

Although VBR coding is more efficient than CBR coding, the burstiness of VBR video traffic brings great difficulty to network resource management. To address this problem, we propose a novel wavelet-based traffic smoothing (WTS) algorithm. Unlike existing algorithms, which only have one resolution, the WTS algorithm has the multiresolutional property that is preferable for smoothing VBR video traffic that exhibits a self-similar behavior. WTS allows traffic smoothing at multiple resolutions and the best transmission schedule is searched as a pruned subtree of a full binary tree, which corresponds to the original VBR video traffic. WTS optimizes several metrics simultaneously for both the single and multiple-flow case while traditional algorithm only optimize one or two metrics for a single flow. The computation complexity of the WTS algorithm is also lower.
DTIC
Smoothing; Wavelet Analysis

20030065951 NASA Marshall Space Flight Center, Huntsville, AL, USA
General Equation Set Solver for Compressible and Incompressible Turbomachinery Flows
Sondak, Douglas L.; Dorney, Daniel J.; [2002]; 9 pp.; In English; 39th AIAA Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A02, Hardcopy

Turbomachines for propulsion applications operate with many different working fluids and flow conditions. The flow may be incompressible, such as in the liquid hydrogen pump in a rocket engine, or supersonic, such as in the turbine which may drive the hydrogen pump. Separate codes have traditionally been used for incompressible and compressible flow solvers. The General Equation Set (GES) method can be used to solve both incompressible and compressible flows, and it is not restricted to perfect gases, as are many compressible-flow turbomachinery solvers. An unsteady GES turbomachinery flow solver has been developed and applied to both air and water flows through turbines. It has been shown to be an excellent alternative to maintaining two separate codes.
Author
Turbomachinery; Compressible Flow; Incompressible Flow; Working Fluids; Analysis (Mathematics)

20030065967 NASA Ames Research Center, Moffett Field, CA, USA
Evaluation of Genetic Algorithm Concepts using Model Problems, Part 1, Single-Objective Optimization
Holst, Terry L.; Pulliam, Thomas H.; May 22, 2003; 30 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy
A genetic-algorithm-based optimization approach is described and evaluated using a simple hill-climbing model problem. The model problem utilized herein allows for the broad specification of a large number of search spaces including spaces with an arbitrary number of genes or decision variables and an arbitrary number hills or modes. In the present study, only single objective problems are considered. Results indicate that the genetic algorithm optimization approach is flexible in application and extremely reliable, providing optimal results for all problems attempted. The most difficult problems - those with large hyper-volumes and multi-mode search spaces containing a large number of genes - require a large number of function evaluations for GA convergence, but they always converge.
Author
Genetic Algorithms; Models; Problems

20030066174 Vanderbilt Univ., Nashville, TN
Analysis of Bivariate and Trivariate Macro-Elements for Surface Fitting
Schumaker, Larry L.; Apr. 30, 2002; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-99-1-0160
Report No.(s): AD-A413753; ARO-39856.21-MA; No Copyright; Avail: CASI; A01, Hardcopy
The work performed under this grant has focused on developing specific spline tools (and the necessary underlying theory). The results can be of use for a variety of applied problems, including for example a) scattered data fitting of very large data sets (such as arise in digital terrain modelling, geosciences, meteorology, etc.), and b) numerical solution of boundary-value problems by finite-element methods. The work has resulted in a total of 16 research papers.
DTIC
Interpolation; Finite Element Method; Terrain

65
STATISTICS AND PROBABILITY

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

20030065609 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Shortest Path Problems in a Stochastic and Dynamic Environment
Cho, Jae I.; Mar. 2003; 158 pp.; In English
Report No.(s): AD-A412850; AFIT/GSE/ENS/03-01; No Copyright; Avail: CASI; A08, Hardcopy
In this research, we consider stochastic and dynamic transportation network problems. Particularly, we develop a variety of algorithms to solve the expected shortest path problem in addition to techniques for computing the total travel time distribution along a path in the network. First, we develop an algorithm for solving an independent expected shortest path problem. Next, we incorporate the inherent dependencies along successive links in two distinct ways to find the expected shortest path. Since the dependent expected shortest path problem cannot be solved with traditional deterministic approaches, we develop a heuristic based on the K-shortest path algorithm for this dependent stochastic network problem. Additionally, transient and asymptotic versions of the problem are considered. An algorithm to compute a parametric total travel time

distribution for the shortest path is presented along with stochastically shortest path measures. The work extends the current literature on such problems by considering interactions on adjacent links.
DTIC
Algorithms; Stochastic Processes

20030065715 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
A Stochastic Model for Joint Reception, Staging, Onward Movement, and Integration (JRSOI)
Sherman, Nathan P.; Mar. 2003; 99 pp.; In English
Report No.(s): AD-A412955; AFIT/GOR/ENS/03-21; No Copyright; Avail: CASI; A05, Hardcopy

A stochastic model for the performance evaluation of a key phase in the deployment process, namely Joint Reception, Staging, Onward Movement, and Integration (JRSOI) is presented. The process is modeled as an open, multi-class tandem queueing network wherein personnel and various classes of cargo are modeled as the flow entities and the stages of the process constitute individual queueing stations. Single and multiple-class models at both low and high resolutions are presented. No analytical stochastic model of this process currently exists in the literature or in practice. The model provides a quick look at key aggregate performance measures such as system throughput and closure, and can be used to expediently identify problems occurring during JRSOI and the impact they have on the process. This information can substantially aid decision makers in regulating process flow. The queueing network model developed here can easily be expanded and adapted to any potential area of conflict. Numerical comparisons with Monte-Carlo simulation demonstrate that the model provides a viable, novel approach to the problem. (30 tables, 2 figures, 29 refs.)
DTIC
Queueing Theory; Stochastic Processes; Deployment

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

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

20030065593 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Models for Sortie Generation with Autonomic Logistics Capabilities
Yager, Nicholaus A.; March 2003; 74 pp.; In English
Report No.(s): AD-A412959; AFIT/GOR/ENS/03-25; No Copyright; Avail: CASI; A04, Hardcopy

The primary objective of this research is to investigate the impact of an autonomic logistics system (ALS) on the sortie generation process for an individual airbase. As in some prior studies of this process, the methodology used to model the sortie generation process is a queueing network containing fork-join nodes for concurrent maintenance activities. The sortie generation rate is commonly regarded as the primary performance measure of the sortie generation process. This measure coincides with the throughput and is used to compare two models: (1) pre-ALS operations and (2) ALS-enhanced airbase operations. Analysis of the models shows that the ALS model yields higher sortie generation rates under a variety of scenarios resulting from the differences in the sortie generation process that are inherent when an ALS is implemented. These results demonstrate that implementation of an ALS will positively impact the sortie generation process by increased sortie generation rates with equivalent or reduced resource levels.
DTIC
Logistics Management; Operations Research

20030065692 Wayne State Univ., Detroit, MI
Part I: Effect of Nitric Oxide and Other Diluents on Cold Starting, Combustion Instability, and White Smoke Emissions in Diesel Engines. Part II: autoignition, Combustion Instability and White Smoke Under Transient Conditions With JP-8
Henein, Naeim A.; Apr. 16, 2003; 73 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0285
Report No.(s): AD-A413344; ARO-37730.1-E6; No Copyright; Avail: CASI; A04, Hardcopy

This report covers an investigation aimed at developing electronic control strategies to improve the cold startability of diesel engines for military, dual-use and hybrid electric vehicles. The emphasis is on the analysis the processes that affect the cranking and acceleration modes during starting. The analysis indicated that NO present in the residual and recirculated gases has on effect on the order or the activation energy of the global autoignition reactions. The mathematical models developed

for the two modes are able to determine the zones of misfiring, the number of cranking cycles and the causes of misfiring after firing, known as combustion instability. Furthermore, the research identified the strategy needed to reduce combustion instability. Also, the models developed in this work showed very clearly that the Cetane number is not a good indicator of the startability of the engine, and that fuel volatility plays a major part in the success of the autoignition process. In this regard JP-8 proved to be a better fuel that DF2, as far as the number of cranking cycles. However, its combustion is unstable if compared with DF2. The results indicated that the problems with cold starting of diesel engines with JP-8 are caused by the fuel injection strategy used in the commercial engines.
DTIC
Combustion Stability; Diesel Engines; Diluents; Jp-8 Jet Fuel; Mathematical Models; Nitric Oxide; Ignition; Exhaust Emission

20030065733 Nebraska Univ., Lincoln, NE, USA
Materials Characterization by Atomic Force Microscopy
Turner, Joseph A.; Apr. 14, 2003; 241 pp.; In English
Contract(s)/Grant(s): F49620-99-1-0254
Report No.(s): AD-A414116; AFRL-SR-AR-TR-03-0188; No Copyright; Avail: CASI; A11, Hardcopy

This research program is focused on the study of the atomic force microscope (AFM) as an instrument for quantitative measuring and imaging material properties with nanoscale resolution. More specific to this research are the dynamic modes of AFM, in which the specimen moves relative to the AFM cantilever tip while in contact. Particular emphases include the higher-order vibration modes and the nonlinear vibration response. In addition to the original objective, improved modeling of AFM cantilevers has been undertaken. The use of simplified beam models with uniform cross section does not reflect the AFM cantilevers that are often used in experiments. High resolution cantilever measurements with a scanning electron microscope (SEM) and modeling with finite element analysis have been used to improve the comparisons between experiments and numerical models.
DTIC
Atomic Force Microscopy; Mathematical Models; Nanotechnology; Mechanical Properties

20030065742 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Linear Programming and Genetic Algorithm Based Optimization for the Weighting Scheme of a Value Focused Thinking Hierarchy
Thawley, David M.; Mar. 25, 2003; 105 pp.; In English; Original contains color illustrations
Report No.(s): AD-A412757; AFIT/GOR/ENS/03-24; No Copyright; Avail: CASI; A06, Hardcopy

Deriving weights for a Value Focused Thinking (VFT) hierarchy demands considerable time and input from Decision Makers (DM) and Subject Matter Experts (SME). Often, the DMs and SMEs are the leaders of companies and organizations, and this required time is unrealistic with their schedules. In these situations, as well as scenarios where there no available DMs/SMEs, conventional means of weighting a VFT hierarchy are impossible, and any VFT analysis is halted. When historical data exists on evaluation measures and performance of alternatives, linear programming and genetic algorithm based optimization may be used to derive historically optimal weights for a hierarchy. Analysis may then be done to determine the utility of transposing these weights into a hierarchy to evaluate a current list of alternatives. This type of analysis is also useful in 'first cut' weighting of a hierarchy, and therefore reduces the time demands for DMs/SMEs to complete the weighting process. This methodology can provide insight into any situation where historical information exists on ordinarily ranked, competing alternatives.
DTIC
Genetic Algorithms; Hierarchies; Linear Programming; Organizations

67
THEORETICAL MATHEMATICS

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

20030065730 Georgia Inst. of Tech., Atlanta, GA
Visual Information in a Feedback Loop: A Control/Computer Vision Synthesis
Tannenbaum, Allen; Jan. 1998; 25 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0169
Report No.(s): AD-A414150; ARO-36217.1-C1; No Copyright; Avail: CASI; A03, Hardcopy

This work of this proposal was concerned with the multidisciplinary field controlled active vision which involves the synthesis of techniques from control and computer vision to treat a number of fundamental problems including visual tracking. A key theme of our research was the development of techniques for using visual information in feedback control systems. Controlled active vision is leading to enhanced man-machine interfaces for interactions with computers and more complicated systems such as remote controlled weapons and vehicles. Our work has drawn upon our extensive experience in robust control, and the methods we have been developing for various problems in image processing and computer vision utilizing the theory of geometric variational evolution equations. These techniques have already been applied to visual tracking, automatic target recognition, and problems in biomedical engineering including image-guided surgery. It is important to note that many of these methods were derived from ideas in optimal control. In particular, the geometric variational techniques have been very influenced by concepts from optimal control, and the resulting concept of 'viscosity solution' is a direct consequence of Hamilton-Jacobi theory. For some time now, the role of control theory in vision has been recognized. In particular, the branches of control that deal with system uncertainty, namely adaptive and robust, have been proposed as essential tools in coming to grips with the problems of both biological and machine vision. These problems all become manifest when one attempts to use a visual sensor in an uncertain environment, and to feed back in some manner the information.
DTIC
Computer Vision; Feedback Control; Bioengineering; Control Theory; Image Processing

20030065731 Duke Univ., Durham, NC
Undulatory Flap Propulsion - Reduction to Practice
Howle, Laurens E.; May 10, 2003; 5 pp.; In English
Contract(s)/Grant(s): N00014-99-1-0452
Report No.(s): AD-A414152; No Copyright; Avail: CASI; A01, Hardcopy

We use computational and reduced-order modeling for predictive studies of undulatory propulsion systems. Through the understanding of the factors that affect the performance of undulatory swimmers, we optimize man-made devices that employ novel methods for propulsion such as undulatory flap propulsion.
DTIC
Propulsion System Configurations; Mathematical Models; Flaps (Control Surfaces); Aerodynamics

70
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics, 90 Astrophysics*, or *92 Solar Physics*.

20030065637 North Carolina Univ., Chapel Hill, NC, USA
Quantum Transport, Magnetic Field Sensor, an Integrated Amplification in no el Si/SiGe Heterostructure Devices
Washburn, Sean; May 27, 2002; 6 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0139
Report No.(s): AD-A413988; Rept-35059-EL; No Copyright; Avail: CASI; A02, Hardcopy

Studies of high mobility Si/SiGe heterostructure devices have been analyzed in light of correlations among carriers. Single-particle models fail to describe the metal-insulator transitions observed in them. Attempts to confine the carriers and create lateral tunneling structures and magnetic field sensors have revealed ambiguous results that cannot be distinguished from disorder in the devices but which show some promise for device applications.
DTIC
Magnetic Fields; Quantum Theory; Sensors; Silicon; Germanium Compounds; Heterojunction Devices

20030065784 Texas Univ., Austin, TX, USA
Biomolecular Recognition of Semiconductors and Magnetic Materials to Assemble Nanoparticle Heterostructures
Belcher, Angela M.; Jan. 2002; 14 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-01-1-0456
Report No.(s): AD-A413918; ARO-41358.2-LS-YIP; No Copyright; Avail: CASI; A03, Hardcopy

We have focused on selecting peptides to control the synthesis of semiconductor and magnetic materials and extended it to multi-dimensional architectures. We have shown that single phage selected for ZnS has a binding site (pill) on one end of

the phage that can nucleate and bind up to 5 ZnS nanoparticles. We took the clones that bind to ZnS nanocrystals through the pill minor coat protein and cloned them into the pVlll major coat protein of the phage. There are 2700 copies of the pVlll protein that self-assemble to make the liner structure of the phage. More importantly, these pVlll proteins are all crystallographically related to each other. So cloning ZnS specific peptides into the crystalline coat allows us to lock in a particular orientation of the peptide on the coat and therefore translate the symmetry of the phage coat to a nucleated nanoparticle. We have used this clone to grow orientated ZnS nanoparticles along the 'backbone' of the phage to make phage ZnS hybrid nanowires. Phage were also used to grow and assemble 2-6 semiconductors, gold nanoparticles and fluorescent molecules into highly ordered liquid crystalline phases and crystalline thin films.
DTIC
Magnetic Materials; Semiconductors (Materials)

20030065786 Clemson Univ., SC, USA
Search for Lower Temperature(T-100K) Thermoelectric Materials in the Pentatelluride System and other Low Dimensional Systems
Tritt, Terry M.; May 16, 2002; 30 pp.; In English
Contract(s)/Grant(s): DAAG55-97-1-0267
Report No.(s): AD-A413956; No Copyright; Avail: CASI; A03, Hardcopy

The main objective of the Clemson / DARPA project is to search for and achieve higher performance low temperature (100 K to 250 K) thermoelectric materials than exist to date. Dr. Tritt's group at Clemson University will perform synthesis and characterization of a number of low dimensional systems which show potential for use in thermoelectric applications. Initially Tritt's group has been and will continue to pursue studies of the low-dimensional pentatelluride materials: HfTe5 and ZrTe5. Tritt's group will perform doping studies of the thermoelectric properties of these materials as well, which will include compounds such as Hf1-XZrXTe5. Subsequent doping studies on this family of compounds will include other substitutions, Hf1-XMXTe5-YZY, where M = Zr, Ta, Nb, Ti etc. and Z = S or Se. Tritt presented the preliminary results of the (Hf1-XZrXTe5) study at the XVI International Conference on Thermoelectrics in Dresden. Other promising low dimensional materials will also begin to be investigated.
DTIC
Low Temperature; Thermoelectricity

71
ACOUSTICS

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

20030065751 Naval Research Lab., Bay Saint Louis, MS
Relationship Between Backscattering and Beam Scattering Coefficients Derived from New Measurements of Light Scattering Phase Functions
Haltrin, Vladimir I.; Lee, Michael; Shybanov, Eugeny; Arnone, Robert A.; Weidemann, Alan D.; Nov. 2002; 10 pp.; In English
Report No.(s): AD-A413945; NRL/PP/7330/02/0058; No Copyright; Avail: CASI; A02, Hardcopy

Processing of optical remote sensing information requires a knowledge of dependence between backscattering and beam scattering coefficients. Until recently this dependency was primarily derived from fifteen angular scattering coefficients measured more than 30 years ago by Petzold 1. A few years ago a new probe to measure an angular scattering coefficient of natural waters was developed and built by the Marine Hydrophysical Institute in Sevastopol, Crimea 2. Since 2000 his device was employed in several LEO- 15 expeditions near the coast of New Jersey, and in May 2002 expedition in the northern Gulf of Mexico.
DTIC
Light Scattering; Backscattering

20030065800 Army Research Lab., Adelphi, MD
A Nondimensional Parameterization for Sound Propagation in the Atmosphere
Mungiole, Michael; Wilson, D. K.; Mar. 2003; 22 pp.; In English
Report No.(s): AD-A413843; ARL-TR-2950; No Copyright; Avail: CASI; A03, Hardcopy

Parabolic equation (PE) techniques have been successfully used to obtain numerical solutions of sound pressure attenuation in which sound propagation is affected by turbulence and vertical gradients in wind and temperature. The PP models generally produce accurate attenuation values, but the execution time is excessive for applications when near real-time results are required. To obtain sound level attenuation predictions at selected location more quickly, we are developing an artificial neural network. As a first step in this effort, the PP and boundary conditions were modified to obtain a nondimensional version, written in the MATLAB code. This nondimensional version was developed to be used to train the artificial neural network because a fewer number of parameters (seven) would be required to be specified, resulting in a reduced number of model runs to develop the training algorithm. This report documents the derivation of the appropriate equations that are used in the modified (nondimensional) version of the acoustic propagation model. In addition, graphical data are provided that identify the sensitivity of sound pressure attenuation to each of the seven nondimensional parameters.
DTIC
Acoustic Attenuation; Sound Pressure; Parabolic Differential Equations; Parameterization; Sound Propagation

20030065861 NASA Langley Research Center, Hampton, VA, USA
The Development of the Ducted Fan Noise Propagation and Radiation Code CDUCT-LaRC
Nark, Douglas M.; Farassat, F.; Pope, D. Stuart; Vatsa, Veer; [2003]; 8 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference and Exhibition, 12-14 May 2003, Hilton Head, SC, USA
Report No.(s): AIAA Paper 2003-3242; No Copyright; Avail: CASI; A02, Hardcopy

The development of the ducted fan noise propagation and radiation code CDUCT-LaRC at NASA Langley Research Center is described. This code calculates the propagation and radiation of given acoustic modes ahead of the fan face or aft of the exhaust guide vanes in the inlet or exhaust ducts, respectively. This paper gives a description of the modules comprising CDUCT-LaRC. The grid generation module provides automatic creation of numerical grids for complex (non-axisymmetric) geometries that include single or multiple pylons. Files for performing automatic inviscid mean flow calculations are also generated within this module. The duct propagation is based on the parabolic approximation theory of R. P. Dougherty. This theory allows the handling of complex internal geometries and the ability to study the effect of non-uniform (i.e. circumferentially and axially segmented) liners. Finally, the duct radiation module is based on the Ffowcs Williams-Hawkings (FW-H) equation with a penetrable data surface. Refraction of sound through the shear layer between the external flow and bypass duct flow is included. Results for benchmark annular ducts, as well as other geometries with pylons, are presented and compared with available analytical data.
Author
Aerodynamic Noise; Ducted Fans; Noise Propagation; Radiation; Grid Generation (Mathematics)

20030065901 NASA Langley Research Center, Hampton, VA, USA
Comparison of Acoustic Impedance Eduction Techniques for Locally-Reacting Liners
Jones, M. G.; Parrott, T. L.; Watson, W. R.; January 2003; 11 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference and Exhibit, 12-14 May 2003, Hilton Head, SC, USA
Report No.(s): AIAA Paper 2003-3306; No Copyright; Avail: CASI; A03, Hardcopy

Typical acoustic liners used in current aircraft inlets and aft-fan ducts consist of some type of perforated facesheet bonded to a honeycomb core. A number of techniques for determining the acoustic impedance of these locallyreacting liners have been developed over the last five decades. In addition, a number of models have been developed to predict the acoustic impedance of locallyreacting liners in the presence of grazing flow, and to use that information together with aeroacoustic propagation codes to assess the noise absorption provided by these liners. These prediction models have incorporated the results from databases acquired with specific impedance eduction techniques. Thus, while these prediction models are acceptable for liners that are similar to those tested in these databases, their application to new liner configurations must be viewed with caution. The primary purpose of this paper is to provide a comparison of impedance eduction techniques that have been implemented at various aerospace research laboratories in the USA (NASA Langley Research Center, General Electric Aircraft Engines, B. F. Goodrich and Boeing). A secondary purpose is to provide data for liner configurations that extend the porosity range beyond that which has been previously used in common aircraft engine nacelles. Two sets of liners were designed to study the effects of three parameters: perforate hole diameter, facesheet thickness and porosity. These two sets of liners were constructed for testing in each of the laboratories listed above. The first set of liners was designed to fit into the NASA Langley and Boeing test facilities. The second set was designed to fit into the General Electric Aircraft Engines and B. F. Goodrich test facilities. By using the same parent material, both sets of liners were identical to within the limits of material and fabrication variability. Baseline data were obtained in the normal incidence impedance tubes at NASA Langley and B. F. Goodrich. The results were found to compare extremely well. The samples were then tested in the grazing flow ducts of each of the four laboratories.

Perhaps the most significant result of these comparisons is that the educed acoustic resistances for the liners used in this study increase as the mean flow profile is modified from uniform to 3-D shear. This realization has demonstrated the need for an frequency-dependent impedance eduction technique that incorporates 3-D shear flow and is efficient.
Author
Acoustic Impedance; Aircraft Engines; Linings; Shear Flow; Ducted Flow; Reacting Flow

20030065909 NASA Glenn Research Center, Cleveland, OH, USA
Computation of Large-Scale Structure Jet Noise Sources With Weak Nonlinear Effects Using Linear Euler
Dahl, Milo D.; Hixon, Ray; Mankbadi, Reda R.; July 2003; 18 pp.; In English; Nineth Aeroacoustics Conference and Exhibit, 12-14 May 2003, Hilton Head, SC, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 22-781-30-12
Report No.(s): NASA/TM-2003-212383; E-13960; NAS 1.15:212383; AIAA Paper 2003-3254; Copyright; Avail: CASI; A03, Hardcopy

An approximate technique is presented for the prediction of the large-scale turbulent structure sound source in a supersonic jet. A linearized Euler equations code is used to solve for the flow disturbances within and near a jet with a given mean flow. Assuming a normal mode composition for the wave-like disturbances, the linear radial profiles are used in an integration of the Navier-Stokes equations. This results in a set of ordinary differential equations representing the weakly nonlinear self-interactions of the modes along with their interaction with the mean flow. Solutions are then used to correct the amplitude of the disturbances that represent the source of large-scale turbulent structure sound in the jet.
Author
Jet Aircraft Noise; Nonlinearity; Supersonic Jet Flow; Euler Equations Of Motion; Aeroacoustics; Mathematical Models

20030065944 United Technologies Corp., East Hartford, CT, USA
TFaNS-Tone Fan Noise Design/Prediction System: Users' Manual TFaNS Version 1.5
Topol, David A.; Huff, Dennis L., Technical Monitor; June 2003; 139 pp.; In English
Contract(s)/Grant(s): NAS3-27727; WBS 781-30-09
Report No.(s): NASA/CR-2003-212380; NAS 1.26:212380; E-13957; No Copyright; Avail: CASI; A07, Hardcopy

TFaNS is the Tone Fan Noise Design/Prediction System developed by Pratt & Whitney under contract to NASA Glenn. The purpose of this system is to predict tone noise emanating from a fan stage including the effects of reflection and transmission by the rotor and stator and by the duct inlet and nozzle. The first version of this design system was developed under a previous NASA contract. Several improvements have been made to TFaNS. This users' manual shows how to run this new system. TFaNS consists of the codes that compute the acoustic properties (reflection and transmission coefficients) of the various elements and writes them to files, CUP3D Fan Noise Coupling Code that reads these files, solves the coupling problem, and outputs the desired noise predictions, and AWAKEN CFD/Measured Wake Postprocessor which reformats CFD wake predictions and/or measured wake data so they can be used by the system. This report provides information on code input and file structure essential for potential users of TFaNS.
Author
Acoustic Properties; Noise Prediction; Prediction Analysis Techniques; User Manuals (Computer Programs); Aerodynamic Noise

20030066217 NASA Langley Research Center, Hampton, VA, USA
Measurement of Insertion Loss of an Acoustic Treatment in the Presence of Additional Uncorrelated Sound Sources
Klos, Jacob; Palumbo, Daniel L.; January 2003; 11 pp.; In English; 9th AIAA/CEAS Aeroacoustics Conference & Exhibition, 12-14 May 2003, Hilton Head, SC, USA
Report No.(s): AIAA Paper 2003-3158; No Copyright; Avail: CASI; A03, Hardcopy

A method to intended for measurement of the insertion loss of an acoustic treatment applied to an aircraft fuselage in-situ is documented in this paper. Using this method, the performance of a treatment applied to a limited portion of an aircraft fuselage can be assessed even though the untreated fuselage also radiates into the cabin, corrupting the intensity measurement. This corrupting noise in the intensity measurement incoherent with the panel vibration of interest is removed by correlating the intensity to reference transducers such as accelerometers. Insertion loss of the acoustic treatments is estimated from the ratio of correlated intensity measurements with and without a treatment applied. In the case of turbulent boundary layer excitation of the fuselage, this technique can be used to assess the performance of noise control methods without requiring treatment of the entire fuselage. Several experimental studies and numerical simulations have been conducted, and results from

three case studies are documented in this paper. Conclusions are drawn about the use of this method to study aircraft sidewall treatments.
Author
Aeroacoustics; Fuselages; Aircraft Noise; Insertion Loss; Noise Intensity; Noise Measurement

72
ATOMIC AND MOLECULAR PHYSICS

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

20030065631 Arizona Univ., Tucson, AZ
Polarization & Diffractive Optics for a Snapshot Imaging Spectropolarimeter
Sabatke, Derek; Locke, Ann; Tehow, Christopher; Dereniak, Eustace; Garcia, John; Oct. 16, 2002; 11 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0811
Report No.(s): AD-A414026; 318810; ARO-42812-PH.1; No Copyright; Avail: CASI; A03, Hardcopy

A snapshot imaging channeled spectropolarimeter is under development. This instrument combines channeled spectropolarimetry and computed tomography imaging spectrometry to enable the capture of spatially and spectrally resolved polarization data with no moving parts. Our goals under this contract were the design and acquisition of two high-order retarders and a computer-generated holographic disperser. These have been accomplished.
DTIC
Diffractive Optics; Imaging Techniques; Polarimeters; Spectroscopy

20030065650 Georgia Tech Research Inst., Atlanta, GA, USA
Quantum Logic with Trapped Atoms in Optical Cavity QED
Chapman, M. S.; You, L.; Kennedy, T. A.; Dec. 2001; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAG55-98-1-0370
Report No.(s): AD-A414035; ARO-P-38818-PH-QC; No Copyright; Avail: CASI; A03, Hardcopy

The principle goal of our program is the demonstration of scalable quantum logic between qubits encoded in the internal states of neutral atoms sharing the quantum field of an optical cavity. This requires successful integration of two leading quantum information technologies atom-based quantum memories and cavity QED-based entanglement generation and manipulation. We have developed methods for trapping atoms inside high-finesse optical resonators for scalable quantum logic. Our configuration employs infrared (CO2) laser traps for individual atoms that will permit us to store many individually addressable atoms and to manipulate these atoms in arbitrary combinations using the quantum field of the optical cavity. Importantly, the use of infrared trapping lasers virtually eliminates decoherence due to atomic spontaneous emission, which hinders many AMO-based systems.
DTIC
Quantum Electrodynamics; Logic Circuits; Quantum Theory; Neutral Atoms; Optics

20030065720 Illinois Univ., Urbana, IL, USA
Quantum Transport and Scattering Time Engineering in Nanostructures
Leburton, Jean-Pierre; Nov. 2002; 6 pp.; In English
Contract(s)/Grant(s): DAAD19-99-1-0129
Report No.(s): AD-A413484; ARO-39055.9-EL; No Copyright; Avail: CASI; A02, Hardcopy

We studied theoretically the electronic properties of single and vertically coupled InAs/GaAs self-assembled quantum dots (SAD) with a computational model which takes into account conduction-valence band mixing through an eight-band strain dependent k.p hamiltonian. In single SADs, we showed that experimental photoluminescence peaks cannot be simply interpreted as transitions between harmonic oscillator states in the valence band and in the conduction band. We also provided a detailed account of electron-hole alignment as a function of external electric fields SAD chemical composition Ga diffusion profile in the dot and the dot shape. In particular, we invalidated the perturbation theory in the interpretation of the interband Stark effect. In vertically stacked coupled SADs we specifically demonstrated the localization of hole states, even for vanishing dot separation. We also predicted the existence of an anomalous Stark effect for interband transitions. We also showed that intraband optical transitions between 1s and 2p bonding states in the conduction band, are strongly enhanced compared with similar transitions in single SADs. These transitions exhibit a strong asymmetric dependence in an external

electric field, due to the SAD morphology. The intraband Stark effect also provides large tunability between electron states for mid-infrared transitions.
DTIC
Nanostructures (Devices); Quantum Dots; Electrical Properties; Photoluminescence; Self Assembly; Nuclear Scattering

20030066215 NASA Ames Research Center, Moffett Field, CA, USA
Theory of Transport of Long Polymer Molecules through Carbon Nanotube Channels
Wei, Chenyu; Srivastava, Deepak; August 19, 2003; 14 pp.; In English
Contract(s)/Grant(s): DTT559-99-D-00437; AS-03; No Copyright; Avail: CASI; A03, Hardcopy

A theory of transport of long chain polymer molecules through carbon nanotube (CNT) channels is developed using Fokker-Planck equation and direct molecular dynamics (MD) simulations. The mean transport or translocation time tau is found to depend on the chemical potential energy, entropy and diffusion coefficient. A power law dependence tau approx. N(sup 2)is found where N is number of monomers in a molecule. For 10(exp 5)-unit long polyethylene molecules, tau is estimated to be approx. 1micro-s. The diffusion coefficient of long polymer molecules inside CNTs, like that of short ones, are found to be few orders of magnitude larger than in ordinary silicate based zeolite systems.
Author
Transport Theory; Carbon Nanotubes; Molecular Dynamics; Molecules; Fokker-Planck Equation; Potential Energy; Diffusion Coefficient

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*.

20030065660 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Parameter Study for Optimizing the Mass of a Space Nuclear Power System Radiation Shield
Kowash, Benjamin R.; Mar. 2002; 118 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414058; AFIT/GNE/ENP/02M-04; No Copyright; Avail: CASI; A06, Hardcopy

A parameter study was conducted for a space nuclear reactor radiation shield. The focus of this research was to explore alternatives to current radiation shield designs to reduce the mass while maintaining the same shielding performance. MCNP4C was used to determine the parameters necessary to build an optimum shield. A design known as the split scatter shield offered some potential for reductions in shield mass. In theory, less material is required for this type of shield, which uses thin shield sections to scatter radiation away from the dose plane. The parameters for this shield design are the shield geometry, number of shield sections, and material selection. Split scatter shielding offers a potential for reducing the shield mass by allowing the gamma shield material to be moved closer to the source plane. Further research needs to be conducted on this shielding technique, however, to isolate optimum shield values. Once these optima have been identified, a split shield can be developed and compared to the original shield performance. Finally, an energy deposition study indicates that the split scatter shield will absorb less energy than the unit shield, implying that there may be less thermal stress on a scatter shield.
DTIC
Nuclear Radiation; Nuclear Reactors; Parameterization; Spacecraft Power Supplies; Radiation Shielding

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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*.

20030065723 California Univ., Irvine, CA
Optical Interactions at Randomly Rough Surfaces
Maradudin, Alexei A.; Mar. 10, 2003; 190 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-1-0321
Report No.(s): AD-A414090; ARO-40364.1-PH; No Copyright; Avail: CASI; A09, Hardcopy

This project is concerned with theoretical and experimental studies of the scattering of light from and its transmission through randomly rough surfaces. The most significant results obtained during the reporting period include the design of one-dimensional random surfaces that transmit light in a specified fashion; the demonstration that the scattering of light from the random surface of an amplifying (gain) medium increases the height of and narrows the enhanced backscattering peak; the prediction of multiple-scattering effects in the second harmonic generation of light in reflection from a clean random metal surface and in transmission through a rough metal film in the Kretchmann attenuated total reflection geometry; the theoretical study of the wavelength dependence of the reflectivity and total scattered energy when p-polarized light is scattered from a rough dielectric film deposited on a metallic substrate; the development of a new perturbation theory of rough surface scattering in which the small parameter is the dielectric contrast between the medium of incidence and the scattering medium; and the observation of spectral changes (Wolf shifts) obtained from a real image of a point source.
DTIC
Light Scattering; Optical Properties; Dielectrics; Metal Surfaces

20030065793 Army Research Lab., Adelphi, MD
Diffractive Effects in the Determination of Damage Thresholds Using Focused Top Hat Beams
Pritchett, Timothy M.; Apr. 2003; 12 pp.; In English
Report No.(s): AD-A413846; ARL-TN-200; No Copyright; Avail: CASI; A03, Hardcopy

An accurate determination of damage thresholds for focal plane elements must correctly account for diffractive effects. This technical note reviews the physics of Fraunhofer diffraction of a top hat beam. It presents a new result. accurate to second order in the subtended solid angle for the encircled energy. It describes in detail the computation of peak and average fluences in the presence of diffraction and it includes a compilation of practical formulae for workers measuring damage threshold fluences.
DTIC
Diffraction; Yield Point; Beams (Radiation)

20030065847 Naval Research Lab., Bay Saint Louis, MS
Temporal Variability of Coastal Waters in Mississippi Bight and New York Bight Sea WiFS and MODIS
Martinloch, Paul; Arnone, Robert; Casey, Brandon; Ladner, Sherwin; Nov. 22, 2002; 13 pp.; In English
Report No.(s): AD-A413727; NRL/PP/7330/02/0064; No Copyright; Avail: CASI; A03, Hardcopy

We demonstrate the utility of SeaWiFS and MODIS to determine coastal optical properties for a one-year period. Optical properties derived from SeaWiFS and MODIS are compared for coastal waters in the Mississippi Bight and the New York Bight. A one-year time series from January 2001 to December 2001 with varying time scales (yearly, monthly, and eight-day composites) were processed with similar processing algorithms to determine the inherent optical properties (absorption and backscattering) of the coastal waters. The similar spectral and spatial resolution and repeat cycles of these sensors provide new methods to determine the temporal changes in the coastal processes. We assess the temporal and spatial variability and regional dependence of the optics in both regions. Processing of MODIS and SeaWiFS imagery was performed using modified NASA standard atmospheric correction methods. For both satellites, a near-infrared (NIR) atmospheric correction method (Arnone et al, 1998) based on the assumption that the normalized water-leaving radiance, nLw, at 765- and 865-nm is not zero in the high turbid waters was applied. For both SeaWiFS and MODIS, this correction reduces the number of negative radiance values and improves the estimation of optical properties in the highly turbid coastal region.
DTIC
Optical Properties; Sea-Viewing Wide Field-Of-View Sensor; Atmospheric Correction; Coasts; Coastal Water

75
PLASMA PHYSICS

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

20030065796 Atmospheric and Environmental Research, Inc., Lexington, MA, USA
Two-Dimensional Transport Studies for the Composition and Structure of the Io Plasma Torus
Smyth, William H.; July 25, 2003; 6 pp.; In English
Contract(s)/Grant(s): NASW-02036
Report No.(s): P-1037; No Copyright; Avail: CASI; A02, Hardcopy

Research efforts in the second quarterly period have been focused primarily upon reviewing and assessing the neutral-plasma reactions and the plasma-plasma reactions that are important in determining the production and loss rates for the primary heavy ion species S(+), S(++), S(+++), O(+), and O(++) in the plasma torus and in acquiring new and updating old cross sections for the important processes.
Author
Io; Toroidal Plasmas; Plasma Interactions; Heavy Ions; Transport Properties; Two Dimensional Models

20030066145 NASA Marshall Space Flight Center, Huntsville, AL, USA
Fundamentals of the Plasma Sail Concept: MHD and Kinetic Studies
Khazanov, G.; Delamere, P.; Kabin, K.; Linde, T. J.; Krivorutsky, E.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

The Mini-Magnetospheric Plasma Propulsion (M2P2), originally proposed by Winglee et al. [2000] predicts that a 15-km standoff distance (or 20-km cross-sectional dimension) of the magnetic bubble will provide for sufficient momentum transfer from the solar wind to accelerate a spacecraft to the unprecedented speeds of 50-80 km/s after an acceleration period of about three months. Such velocities will enable travel out of the solar system in period of about seven years-almost an order of magnitude improvement over present chemical based propulsion systems. However, for the parameters of the simulation of Winglee et al. [2000], a fluid model for the interaction of M2P2 with the solar wind is not valid. It is assumed in the MHD fluid model, normally applied to planetary magnetospheres, that the characteristic scale-size is much greater than the Larmor radius and ion skin depth of the solar wind. In the case of M2P2, the size of the magnetic bubble is actually less than or, comparable to, the scale of these characteristic parameters. Therefore, a kinetic approach, which addresses the small-scale physical mechanisms, must be used. We have adopted a two-component approach to determining a preliminary estimate of the momentum transfer to the plasma sail. The first component is a self-consistent MHD simulation of the small-scale expansion phase of the magnetic bubble. The fluid treatment is valid to roughly 5 km from the source and the steady-state MHD solution at the 5 km boundary was then used as initial conditions for the hybrid simulation. The hybrid simulations showed that the momentum transfer to the innermost regions of the plasma sail is negligible.
Author
Magnetohydrodynamics; Plasma Propulsion; Space Plasmas; Kinetics; Computerized Simulation; Solar Sails

20030066160 NASA Marshall Space Flight Center, Huntsville, AL, USA
Instrument Reflections and Scene Amplitude Modulation in a Polychromatic Microwave Quadrature Interferometer
Dobson, Chris C.; Jones, Jonathan E.; Chavers, Greg; [2003]; 12 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

A polychromatic microwave quadrature interferometer has been characterized using several laboratory plasmas. Reflections between the transmitter and the receiver have been observed, and the effects of including reflection terms in the data reduction equation have been examined. An error analysis which includes the reflections, modulation of the scene beam amplitude by the plasma, and simultaneous measurements at two frequencies has been applied to the empirical database, and the results are summarized. For reflection amplitudes around 1096, the reflection terms were found to reduce the calculated error bars for electron density measurements by about a factor of 2. The impact of amplitude modulation is also quantified. In the complete analysis, the mean error bar for high- density measurements is 7.596, and the mean phase shift error for low-density measurements is 1.2’. .
Author
Microwave Interferometers; Transmitter Receivers; Amplitude Modulation; Electron Density (Concentration); Plasmas (Physics)

76
SOLID-STATE PHYSICS

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

20030065642 NASA Marshall Space Flight Center, Huntsville, AL, USA
Imaging Modulated Reflections from a Semi-Crystalline State of Profilin:Actin Crystals
Lovelace, J.; Bellamy, H.; Snell, E. H.; Borgstahl, G.; [2003]; 1 pp.; In English
Contract(s)/Grant(s): NCC-866; No Copyright; Avail: Other Sources; Abstract Only

Commensurate and incommensurate modulation in protein crystals remain terra incognita for crystallographers. While small molecule crystallographers have successfully wrestled with this type of structure, no modulated macromolecular structures have been determined to date. In this work, methods and strategies have been developed to collect and analyze data from modulated macromolecular crystals. Preliminary data using these methods are presented for a semi-crystalline state of profilin:actin.
Author
Crystals; Imaging Techniques; Modulation; Macromolecules

20030065930 NASA Marshall Space Flight Center, Huntsville, AL, USA
Science Issues Associated with the Use of a Microfluidic Chip Designed Specifically for Protein Crystallization
Holmes, Anna M.; Monaco, Lisa; Barnes, Cindy; Spearing, Scott; Jenkins, Andy; Johnson, Todd; Mayer, Derek; Cole, Helen; [2003]; 1 pp.; In English; American Crystallographic Association (ACA), 26-31 Jul. 2003, Covington, KY, USA; Original contains color illustrations
Contract(s)/Grant(s): NCC8-66; Copyright; Avail: Other Sources; Abstract Only

The Iterative Biological Crystallization team in partnership with Caliper Technologies has produced a prototype microfluidic chip for batch crystallization that has been designed and tested. The chip is designed for the mixing and dispensing of up to five solutions with possible variation of the recipe being delivered to two growth wells. Developments that have led to the successful on-chip crystallization of a few model proteins have required investigative insight into many different areas, including fluid mixing dynamics, surface treatments, quantification and fidelity of reagent delivery. This presentation will encompass the ongoing studies and data accumulated toward these efforts.
Author
Protein Crystal Growth; Crystallization; Fluidics

20030065970 Universities Space Research Association, Huntsville, AL, USA
Perfection of Apoferritin Crystals: An Advanced X-Ray Imaging and Diffraction Study
Hu, Z. W.; Thomas, B. R.; Chernov, A. A.; Chu, Y. S.; [2003]; 1 pp.; In English; American Crystallographic Association Conference, 26-31 Jul. 2003, Covington, KY, USA
Contract(s)/Grant(s): NCC8-66; Copyright; Avail: Other Sources; Abstract Only

Ferritin is a well-known iron-storage protein, and is a spherical shell that consists of 24 identical subunits packed in a 432 symmetry. The typically large protein size and its distinction from lysozyme as to chemical and physical characteristics make ferritin an attractive model protein for crystal growth and perfection investigation-as an alternative to the most widely studied lysozyme. In this contribution, the latest results obtained from coherence-based x-ray diffraction imaging and diffraction experiments will be presented on octahedral apoferritin (a demetalized form of ferritin) crystals grown from various growth conditions. Crystal specimens, which have the measured rocking-curve widths varying from a few arcseconds to several tens arcseconds (or more), are comparatively examined by intrinsically highly sensitive mapping of lattice perfection and defects. The richness of the observed defects and growth features offers insight into perfection and growth of protein crystals. Beautiful interference fringe patterns formed in diffraction images and fine oscillation structure of rocking curves observed will be discussed for understanding of physical origins and the underlying impact.
Author
Protein Crystal Growth; X Ray Imagery; X Ray Diffraction

77
PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

20030065837 California Univ., Los Angeles, CA
Quantum Structural Methods for the Solid State and Surfaces
Starrost, Frank; Carter, Emily A.; Jan. 1999; 36 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0227
Report No.(s): AD-A413986; No Copyright; Avail: CASI; A03, Hardcopy

Our intention is to give a brief survey of advanced theoretical methods used to determine the electronic and geometric structure of solids and surfaces. The electronic structure encompasses the energies and wavefunctions (and other properties

derived from them) of the electronic states in solids, while the geometric structure refers to the equilibrium atomic positions. Quantities that can be derived from the electronic structure calculations include the electronic (electron energies, charge densities), vibrational (phonon spectra), structural (lattice constants. equilibrium structures), mechanical (bulk moduli, elastic constants) and optical (absorption, transmission) properties of crystals. We will also report on techniques used to study solid surfaces, with particular examples drawn from chemisorption on transition metal surfaces.
DTIC
Quantum Theory; Mechanical Properties

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*.

20030066210 Nippon Telegraph and Telephone Public Corp., Japan
NTT Technical Review, Volume 1, No. 3
June 2003; 90 pp.; In English; Copyright; Avail: Other Sources

Topics covered include: Quantum Information Technology. Quantum Cryptography, Quantum Computing with QD Excitons, Quantum Information Technology Based on Single Electron Dynamics, Reading Out Qubid States With a SQUID, Quantum Computers, and Metadata Application Services and Related Technologies.
Derived from text
Information Systems; Quantum Computation; Quantum Computers; Quantum Cryptography; Excitons

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20030066190 NASA Ames Research Center, Moffett Field, CA, USA
(CICT) Computing, Information, and Communications Technology Overview
VanDalsem, William R.; April 17, 2003; 47 pp.; In English; NASA Future Computing and Communications Technologies, 17 Apr. 2003, Moffett Field, CA, USA
Contract(s)/Grant(s): UPN 704-00-00; No Copyright; Avail: CASI; A03, Hardcopy

The goal of the Computing, Information, and Communications Technology (CICT) program is to enable NASA's Scientific Research, Space Exploration, and Aerospace Technology Missions with greater mission assurance, for less cost, with increased science return through the development and use of advanced computing, information and communications technologies. This viewgraph presentation includes diagrams of how the political guidance behind CICT is structured. The presentation profiles each part of the NASA Mission in detail, and relates the Mission to the activities of CICT. CICT's Integrated Capability Goal is illustrated, and hypothetical missions which could be enabled by CICT are profiled. CICT technology development is profiled.
CASI
Computation; Information Management; Spacecraft Communication; NASA Programs

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*.

20030065812 National Academy of Sciences - National Research Council, Washington, DC, USA
Environmental Information for Naval Warfare
Apr. 24, 2003; 216 pp.; In English
Contract(s)/Grant(s): N00014-00-1-0941
Report No.(s): AD-A413831; No Copyright; Avail: CASI; A10, Hardcopy

Efforts to collect, assimilate, analyze, and disseminate information about and predict the nature and significance of the environmental character of the naval battlespace have been the focus of a complex meteorological and oceanographic effort referred to within the U.S. Naval Forces as METOC. To aid in the development of an investment strategy to enhance the value of METOC contributions to battlespace awareness. the Office of the Oceanographer of the Navy and the Office of Naval Research requested that the National Academies undertake a two year effort to: develop a framework process that can be adapted by the U.S. Naval Forces to prioritize what data should be collected and how the data should be managed, what new models should be developed and what improvements should be made to existing models, which data fusion and value-added products should be developed to effectively and efficiently disseminate environmental information to naval units; identify those segments of the process that would benefit from targeted research (e.g., specific ocean processes or general areas of uncertainty); and prioritize the proposed improvements by identifying which actions are most needed and achievable as well as those that are most likely to make a significant and positive impact.
DTIC
Marine Environments; Navy; Data Acquisition; Data Management; Standards; Oceanography

20030065849 Army War Coll., Carlisle Barracks, PA
Training Effects on Judgment Accuracy in a Computer-Mediated Environment
Lankowski, Mark M.; Mar. 2003; 84 pp.; In English; Original contains color illustrations
Report No.(s): AD-A413680; AFIT/GIR/ENV/03-10; No Copyright; Avail: CASI; A05, Hardcopy

The USA Air Force (AF) has named Information Superiority the core competency 'upon which all the other core competencies rely'. In order to achieve Information Superiority, deceptive communication must be minimized. According to researchers, deception occurs when communicators control the information contained in their messages to convey a meaning that departs from the truth. This research draws on Biros, George, and Zmuds' (2002) deception research model to determine if training to detect deception will improve a person's deception detection performance in a computer-mediated environment. A longitudinal experiment was conducted with AF participants (N=119) where three separate training plans were provided as the treatments, and measurements of the participants' deception detection performance were taken before and after each of the three treatments. Each measurement was taken in the form of six judgment scenarios provided through three forms of computer-mediated communication. Partial support was found for training improving deception detection performance and reducing the number of false alarms in a computer-mediated environment, based upon the first training treatment and a combination of the first and second training treatments. However, contradictory results came from the second and third training treatments. The most significant finding was that the performance of AF participants attempting to detect deception in a computer-mediated environment could be improved by a training session. Further research should explore the best training methods to improve the deception detection performance of all AF members in order to achieve the goal of Information Superiority.
DTIC
Detection; Deception; Computer Networks

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*.

20030065879 NASA Langley Research Center, Hampton, VA, USA
Space Colonization Using Space-Elevators from Phobos
Weinstein, Leonard M.; [2003]; 9 pp.; In English; Space Technology and Applications International Forum, 2-6 Feb. 2003, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

A novel approach is examined for creating an industrial civilization beyond Earth. The approach would take advantage of the unique configuration of Mars and its moon Phobos to make a transportation system capable of raising mass from the surface of Mars to space at a low cost. Mars would be used as the primary location for support personnel and infrastructure. Phobos would be used as a source of raw materials for space-based activity, and as an anchor for tethered carbon-nanotube-based space-elevators. One space-elevator would terminate at the upper edge of Mars' atmosphere. Small craft would be launched from Mars' surface to rendezvous with the moving elevator tip and their payloads detached and raised with solar powered loop elevators to Phobos. Another space-elevator would be extended outward from Phobos to launch craft toward the Earth/Moon system or the asteroid belt. The outward tip would also be used to catch arriving craft. This approach would allow

Mars to be colonized, and allow transportation of people and supplies from Mars to support the space industry. In addition, large quantities of material obtained from Phobos could be used to construct space habitats and also supply propellant and material for space industry in the Earth/Moon system as well as around Mars.
Author
Mars Bases; Space Colonies; Carbon Nanotubes; Phobos; Space Transportation

20030066213 NASA Marshall Space Flight Center, Huntsville, AL, USA
Plasmaspheric Mass Loss and Refilling as a Result of a Magnetic Storm
Reinisch, B. W.; Huang, X.; Song, P.; Green, J. L.; Fung, S. F.; Vasyliunas, V. M.; Gallagher, D. L.; Sandel, B. R.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Using the sounding measurements from the radio plasma imager on IMAGE, and a plasma density inversion algorithm, we derive the plasma density profiles along the magnetic field in a few L-shells every 14 hours at magnetic local noon before, during, and after the March 31,2001 magnetic storm. An empirical model of the plasmaspheric plasma density distribution is derived as a reference using the measurements before the storm. During the storm, the equatorial plasma was substantially depleted in a range of L-shells. The flux tubes were refilled after the storm. The filling ratio, the equatorial plasma density normalized by its quiet-time value before the storm, is introduced to assess the time evolution of the depletion and refilling processes. The depletion, more than two thirds of the quiet time content, appeared to occur rather quickly after the storm onset, as determined by the limited temporal resolution of the measurements. The refilling proceeded, although more slowly than the depletion process, significantly faster than the theoretical prediction of a 3-day time scale. Dynamic structures are observed in situ and confirmed by the extreme ultraviolet imager (EUV) measurements.
Author
Magnetic Storms; Plasmasphere; Plasma Density; Magnetic Flux; Extreme Ultraviolet Radiation; Density Distribution

89
ASTRONOMY

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

20030065798 California Inst. of Tech., Pasadena, CA, USA
Brown Dwarfs: Discovery and Detailed Studies
Kulkarni, Shrinivas R.; July 2003; 1 pp.; In English
Contract(s)/Grant(s): NAG5-10588; No Copyright; Avail: CASI; A01, Hardcopy

The grant supported my research and that of my student (Ben Lane) and post-doctoral fellow (Zapatero Osorio). We were productive as can be seen from the list of publications below. In particular, we note three firsts. Using the exquisite angular resolution provided by the AO system at Keck we were able to directly determine the masses of two objects and show that one was a brown dwarf -- the first direct determination of the mass of a brown dwarf. Next, Mr. Lane reported the first direct demonstration of pulsations of a Cepheid star (this report received attention in the popular press). Finally, Dr. Zapatero Osorio continued her work on the search for young brown dwarfs and planets in young clusters with considerable success -- namely the detection of objects with mass below 10 M_J (these can be plausibly argued to be freely floating planets). Mr. Lane graduated and is now a Pappalardo Fellow at MIT and Dr. Zapatero Osorio obtained a position back in her home country.
Author
Stellar Mass; Brown Dwarf Stars; Cepheid Variables; Planet Detection; Extrasolar Planets

20030065961 NASA Ames Research Center, Moffett Field, CA, USA
Science Rationale for Jupiter Entry Probe as Part of JIMO
Young, Richard E.; Spilker, T. R.; [2003]; 1 pp.; In English; Jupiter Icy Moon Community Workshop, 11-13 Jun. 2003, Houston, TX, USA
Contract(s)/Grant(s): RTOP 344-50-92-02; No Copyright; Avail: CASI; A01, Hardcopy

A Jupiter atmospheric entry probe as part of JIMO is a cost effective way to address fundamental science questions identified in the National Research Council Solar System Exploration Decadal Survey (SSEDS): New Frontiers in the Solar System, An Integrated Exploration Strategy. Compared to either the cost of an entirely separate Jupiter mission, or the cost of JIMO itself, inclusion of such a probe on JIMO would be cost advantageous. The probe itself could be relatively simple, and could build on the Galileo Probe heritage. Determining the abundance of water in the Jovian atmosphere would be the

most useful function the probe could perform. The probe could also investigate the composition, dynamics, and thermal structure of the Jovian atmosphere.
Derived from text
Jupiter Atmosphere; Jupiter Probes; Mission Planning

20030065963 NASA Marshall Space Flight Center, Huntsville, AL, USA
Evidence for Filamentary Jet Structure: The Light Curve of GRB 011211
Jakobsson, P.; Hjorth, J.; Ramirez-Ruiz, E.; Kouveliotou, C.; Pedersen, K.; Fynbo, J. P. U.; Gorosabel, J.; Watson, D.; Jensen, B. L.; Gray, T., et al.; [2003]; 1 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

We report on the discovery of the optical afterglow of the X-ray rich, long-duration gamma-ray burst GRB 011211, and the oscillatory behavior present in its optical and X-ray afterglow light curve. The time scale of the fluctuations, -1 hour, is much smaller than the time of the observations, -12 hours from the onset of the gamma-ray burst. The character and strength of the fluctuations visible in the optical data are unprecedented, and are inconsistent with causally connected variations in the emission of a symmetric, relativistic blast wave. Moreover, the differential time lag between the short-term variations in X-ray and optical energies suggests they do not arise from the same emitting region. Such variability may imply that local spherical symmetry is broken because the energy content across the jet-emitting surface is not uniform, indicating the detection of a small scale substructure within the jet itself.
Author
Afterglows; Gamma Ray Bursts; X Rays

20030066168 NASA Marshall Space Flight Center, Huntsville, AL, USA
Preliminary analysis of a CME observed by SOHO and Ulysses Experiments
Bemporad, A.; Poletto, G.; Romoli, M.; Suess, S. T.; ESA-SP Conference Proceedings; [2003]; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Over the last week of November 2002 SOHO/LASCO observed several Coronal Mass Ejections, most of which occurring in the NW quadrant. At that time SOHO/UVCS was involved in a SOHO-Sun-Ulysses quadrature campaign, making observations off the west limb of the Sun, at a northern latitude of 27 deg. Here we focus on data taken at 1.7 solar radii, over a time interval of approx. 7 hours, on 26/27 November 2002, when a large streamer disruption was imaged by LASCO C2 and C3 coronagraphs. UVCS spectra revealed the presence of lines from both high and low ionization ions, such as C III, O VI, Si VIII, IX, and XII, Fe X and XVIII, which brighten at different times, with a different time scale and at different positions and are apparently related to different phenomena. In particular, the intensity increase and fast disappearance of the C III 977 Angstrom line represents the passage through the UVCS slit of cold material released in a jet imaged by EIT in the He II 304 Angstrom line. The persistent presence of the Fe XVIII 974 Angstrom line is not easily related to any special feature crossing the UVCS slit. We suggest to interpret this behavior in terms of the reconnection events which lead to the formation of loops observed in the EIT He II 304 Angstrom line.
Author
Coronal Mass Ejection; Quadrants; Ionization; Magnetic Field Reconnection

90
ASTROPHYSICS

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

20030065736 Northwest Research Associates, Inc., Bellevue, WA
Applying New Methods to Flare Prediction Using Photospheric Vector Magnetic Field Data
Leka, K. D.; Feb. 28, 2003; 34 pp.; In English
Contract(s)/Grant(s): F49620-00-C-0004
Report No.(s): AD-A414155; NWRA-CORA-03-R253; AFRL-SR-AR-TR-03-0145; No Copyright; Avail: CASI; A03, Hardcopy

SOLAR The feasibility of using photospheric vector magnetic field data for solar flare prediction is tested using three distinct approaches. First, we examine on a case-by-case basis, the magnitude and variations of over eighty parameters (almost two hundred when both mean and slope are considered), derived from the vector magnetic field data which describe the magnetic state of the active-region photosphere. We find that when pre-event variations and levels are examined using both flare-producing and flare-quiet regions, any obvious or uniquely flare-related signatures are rare. Second, a statistical approach

is used for all parameters and all seven active regions (ten flares and fourteen flare-free samples). We demonstrate that (1) combinations of parameters can be found which perfectly distinguish between flare-imminent and flare-quiet samples, but (2) that these combinations are not unique, primarily due to the small sample; still, (3) we are able to identify parameterizations of the distribution of electric current density, magnetic-field twist, and current helicity as well as neutral-line shear angle which routinely appear in well-performing discriminant functions. Third, we demonstrate an application of the Magnetic Charge Topology model to photospheric data, with which we can quantify the complexity of the coronal fields as related to flare events.
DTIC
Photosphere; Vectors (Mathematics); Solar Physics; Topology; Solar Flares; Magnetic Fields

20030065835 NASA Marshall Space Flight Center, Huntsville, AL, USA
Gamma-Ray Bursts
Fishman, Gearld J.; [2003]; 1 pp.; In English; 2003 IAU Colloquium #192, 22-26 Apr. 2003, Supernova, Valencia, Spain; No Copyright; Avail: Other Sources; Abstract Only

Gamma-ray bursts originate from cosmological distances and represent the largest known explosions in the Universe. The observed temporal and spectral characteristics of bursts in the gamma-ray region, primarily from data obtained with the BATSE experiment on the Compton Observatory, will be described. The talk will concentrate on recent studies of burst properties, correlations of GRB parameters and other statistical studies that have recently come to light. A summary of recent discoveries and observations in other wavelength regions will also be presented, along with their implications for models of the burst emission mechanism. Various models for the energy source of gamma-ray bursts will be described.
Author
Gamma Ray Bursts; Emission

20030065857 Alabama Univ., Huntsville, AL, USA
On the Consistency of Gamma-Ray Burst Spectral Indices with the Synchrotron Shock Model
Preece, R. D.; Briggs, M. S.; Giblin, T. W.; Mallozzi, R. S.; Pendleton, G. N.; Paciesad, W. S.; Band, D. L.; The Astrophysical Journal; 2002; Volume 581, pp. 1248-1255; In English
Contract(s)/Grant(s): NAG5-7972; Copyright; Avail: Other Sources

The current scenario for gamma-ray bursts (GRBs) involves internal shocks for the prompt GRB emission phase and external shocks for the afterglow phase. Assuming optically thin synchrotron emission from isotropically distributed energetic shocked electrons, GRB spectra observed with a low-energy power-law spectral index greater than -2/3 (for positive photon number indices E(exp alpha) indicate a problem with this model. For spectra that do not violate this condition, additional tests of the shock model can be made by comparing the low- and high-energy spectral indices, on the basis of the model's assertion that synchrotron emission from a single power-law distribution of electrons is responsible for both the low-energy and the high-energy power-law portions of the spectra. We find in most cases that the inferred relationship between the two spectral indices of observed GRB spectra is inconsistent with the constraints from the simple optically thin synchrotron shock emission model. In this sense, the prompt burst phase is different from the afterglow phase, and this difference may be related to anisotropic distributions of particles or to their continual acceleration in shocks during the prompt phase.
Author
Gamma Ray Bursts; Shock Waves; Emission Spectra

20030065975 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Centaurus A: Source Populations in the Nearest Bright Elliptical
Mushotzky, Richard, Technical Monitor; Murray, Stephen S.; July 2003; 3 pp.; In English
Contract(s)/Grant(s): NAG5-10002; No Copyright; Avail: CASI; A01, Hardcopy

The XMM/Newton observations of the nearby radio galaxy, Centaurus A, have proven to be a rich data set and has given us new insights into several important processes present in Centaurus A. A list of publications, conference proceedings, and conference abstracts related to these data are attached at the end of this document. We have used the XMM/Newton observations to study the interaction between the relativistic, radio emitting plasma emitted from active nuclei with the hot interstellar medium. Centaurus A is the nearest radio galaxy, so that we have been able to study these features at a linear resolution unattainable for any similar object.
Derived from text
Elliptical Galaxies; Radio Galaxies; X Ray Astronomy; Relativistic Plasmas; Active Galactic Nuclei; Interstellar Matter; Bibliographies

20030066133 California Univ., Los Angeles, CA, USA
Cosmochemical Studies: Meteorites and their Parent Asteroids
Wasson, John T.; [2003]; 3 pp.; In English
Contract(s)/Grant(s): NAG5-12058; No Copyright; Avail: CASI; A01, Hardcopy

This a final technical report that focuses on cosmochemical studies of meteorites and their parent asteroids. The topics include: 1) Formation of iron meteorites and other metal rich meteorites; 2) New perspectives on the formation of chondrules; and 3) Consequences of large aerial bursts. Also a list of seven papers that received significant support from this research are included.
CASI
Asteroids; Cosmochemistry; Mineralogy; Iron Meteorites

20030066136 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
A 4 MPC X-Ray Filament Falling into the Cluster A85
Forman, William; Mushotzky, Richard, Technical Monitor; July 2003; 2 pp.; In English
Contract(s)/Grant(s): NAG5-10044; No Copyright; Avail: CASI; A01, Hardcopy

We have completed a first paper confirming the ROSAT observation of a merging filamentary structure associated with the rich cluster A85. We detected a portion of the extended 4 Mpc filament first seen by the ROSAT PSPC. We confirm that there is an extended feature, aligned at the same position angle as the major axis of the central cD, the bright cluster galaxies, and nearby groups and clusters. We find that the X-ray emission from the filament is best described by thermal emission with a temperature of approx. 2 keV, which is significantly lower than the ambient cluster medium, but is significantly higher than anticipated for a gas in a weakly bound extended filament. It is not clear whether this is a filament of diffuse emission, a chain of several groups of galaxies, or stripped gas from the infalling south blob. In conclusion, the XMM-Newton observations confirmed that there really is a highly elongated filamentary like structure extending from the the merging south clump to the south east of Abell-85 along the direction defined by all the structures pointed out by Durret et al. (1998b). The fact that the spatial structure of the X-ray filament detected by XMM-Newton cannot be exactly superimposed to that obtained from ROSAT data shows that it is still difficult to determine exactly its nature. However, the X-ray spectrum from this structure is most likely thermal and its temperature is about 2.0 keV, consistent with that of groups. This value is notably cooler than that of the main cluster: the temperature map by Markevitch et al. (1998) shows the presence of gas at about 3-4 keV in the region at a distance from the cluster center at least as far as the northern part of the ellipse. So, we appear to be seeing cool gas as it enters the cluster core. Another possibility is that the filament is associated with the wake of cool stripped gas left behind by the south blob as it falls onto the cluster. In this case, the 'filament', whether it is diffuse or made of groups, would not really be a filament in the large scale structure formation sense. Besides X-ray observations with a much better signal to noise ratio, which probably will have to wait for the next generation of X-ray satellites, optical data can shed light on this question. With this purpose, we intend to perform wide field imaging in various bands to estimate galaxy photometric redshifts and determine how galaxies are distributed in the 'filament' area.
Author
X Ray Astronomy; Thermal Emission; Galactic Clusters; Interacting Galaxies

20030066199 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Solar Chromosphere/Corona Interface, I, FUV-EUV Observations and Modeling of Unresolved Coronal Funnels
Martinez-Galarce, D. S.; Walker, A. B. C.; Barbee, T. W., II; Hoover, R. B.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

A coronal funnel model, developed by Rabin (199l), was tested against a calibrated spectroheliogram recorded in 171 - 175 Angstrom bandpass. This image was recorded on board a sounding rocket experiment flown on 1994 November 3, called the Multi-Spectral Solar Telescope Array, II (MSSTA II), MSSTA, a joint project of Stanford University, the NASA Marshall Space Flight Center and the Lawrence Livermore National Laboratory, is an observing platform composed of a set of normal-incidence, multilayer-coated optics designed to obtain narrow bandpass, high resolution images (1 - 3 arc sec) at selected FUV, EUV and soft X-ray wavelengths (44 Angstroms - 1550 Angstroms). Using full-disk images centered at 1550 Angstroms (C IV) and 173 Angstroms (FE IX/X), the funnel model, which is based on coronal back-heating, was tested against the data incorporating observed constraints on global coverage and measured flux. Found, was a class of funnel models that could account for the quiescent, globally diffuse and unresolved emission seen in the 171 - 175 Angstrom bandpass, where the funnels are assumed to be rooted in the C IV supergranular network. These models, when incorporated with the Chianti spectral code, suggest that this emission is mostly of upper transition region origin and primarily composed of FE IX plasma. The funnels are found to have constrictions, Gamma approx. 6 - 20, which is in good agreement with the observations. Further,

the fitted models simultaneously satisfy global areal constraints seen in both images; namely, that a global network of funnels must cover approx. 70 - 95 % of the total solar surface area seen in the 171 - 175 Angstrom image, and = 45 % of the disk area seen in the 1550 Angstrom bandpass. These findings support the configuration of the EUV magnetic network as suggested by Reeves et af. (1974) and put forth in more detail by Gabriel (1976). Furthermore, the models are in good agreement with differential emission measure estimates made of the transition region by Raymond & Doyle (1981) for temperatures, 250,000 K = T = 650,000 K, based on full-disk observations made on board by SkyLab.
Author
Solar Corona; Chromosphere; Funnels; Solar Arrays

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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*.

20030065746 NASA Ames Research Center, Moffett Field, CA, USA
Principles for Integrating Mars Analog Science, Operations, and Technology Research
Clancey, William J.; April 1, 2003; 2 pp.; In English; Workshop on Analog Sites and Facilities for the Human Exploration of the Moon and Mars, 21-23 May 2003, Golden, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

During the Apollo program, the scientific community and NASA used terrestrial analog sites for understanding planetary features and for training astronauts to be scientists. Human factors studies (Harrison, Clearwater, & McKay 1991; Stuster 1996) have focused on the effects of isolation in extreme environments. More recently, with the advent of wireless computing, we have prototyped advanced EVA technologies for navigation, scheduling, and science data logging (Clancey 2002b; Clancey et al., in press). Combining these interests in a single expedition enables tremendous synergy and authenticity, as pioneered by Pascal Lee's Haughton-Mars Project (Lee 2001; Clancey 2000a) and the Mars Society s research stations on a crater rim on Devon Island in the High Canadian Arctic (Clancey 2000b; 2001b) and the Morrison Formation of southeast Utah (Clancey 2002a). Based on this experience, the following principles are proposed for conducting an integrated science, operations, and technology research program at analog sites: 1) Authentic work; 2) PI-based projects; 3) Unencumbered baseline studies; 4) Closed simulations; and 5) Observation and documentation. Following these principles, we have been integrating field science, operations research, and technology development at analog sites on Devon Island and in Utah over the past five years. Analytic methods include work practice simulation (Clancey 2002c; Sierhuis et a]., 2000a;b), by which the interaction of human behavior, facilities, geography, tools, and procedures are formalized in computer models. These models are then converted into the runtime EVA system we call mobile agents (Clancey 2002b; Clancey et al., in press). Furthermore, we have found that the Apollo Lunar Surface Journal (Jones, 1999) provides a vast repository or understanding astronaut and CapCom interactions, serving as a baseline for Mars operations and quickly highlighting opportunities for computer automation (Clancey, in press).
Derived from text
Research And Development; Technology Utilization; Analogs; Mars (Planet); Manned Mars Missions; Mars Surface

20030065893 California Univ., Los Angeles, CA, USA
Initial Results on the Extraterrestrial Component of New Sediment Cores Containing Deposits of the Eltanin Impact Event
Kyte, Frank T.; Gersonde, Rainer; [2003]; 1 pp.; In English
Contract(s)/Grant(s): NAG5-9441; Copyright; Avail: Other Sources; Abstract Only

Background The impact of the Eltanin asteroid into the Bellingshausen Sea (2.15 Ma) is the only known impact in a deep-ocean (approx. 5 km) basin. In 1995, Polarstern expedition ANT XII/4 made the first geological survey of the suspected impact region. Three sediment cores sampled around the San Martin seamounts (approx. 57.5 S, 91 W) contained well-preserved impact deposits. Sediments of Eocene age and younger were ripped up and redeposited by the impact. The depositional sequence produced by the impact has three units: a chaotic assemblage of sediment fragments up to 50 cm, followed by laminated sands deposited as a turbulent flow, and finally silts and clays that accumulated from dispersed sediments in the water column. The meteoritic impact ejecta, which is composed of shock-melted asteroidal materials and unmelted meteorites, settled through the water column and concentrated near the top of the laminated sands.
Author
Asteroids; Deposits; Fragments; Hypervelocity Impact

20030065968 Wellesley Coll., MA, USA
Laboratory Measurements of SO2 and N2 Absorption Spectra for Planetary Atmospheres
Stark, Glenn; July 8, 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG5-9059; No Copyright; Avail: CASI; A01, Hardcopy

This laboratory project focuses on the following topics: 1) Measurement of SO2 ultraviolet absorption cross sections; and 2) N2 band and Line Oscillator Strengths and Line Widths in the 80 to 100 nm region. Accomplishments for these projects are summarized.
CASI
Absorption Spectra; Planetary Atmospheres; Sulfur Dioxides; Nitrogen

20030065980 NASA Marshall Space Flight Center, Huntsville, AL, USA
Planetary Defense: Options for Deflection of Near Earth Objects
Adams, Robert B.; Alexander, Reginald; Bonometti, Joseph; Chapman, Jack; Fincher, Sharon; Hopkins, Randall; Kalkstein, Matthew; Philips, Al; Polsgrove, Tara; Statham, Geoffrey, et al.; [2002]; 1 pp.; In English; Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; No Copyright; Avail: Other Sources; Abstract Only

In FY 2002 a team of engineers and scientists at MSFC conducted a preliminary investigation of the options for deflecting a Near Earth Object (NEO) fiom a collision course with the earth. A general discussion of the current threat facing the earth from NEO s is outlined. A suite of tools were developed to model inbound and outbound trajectories, propulsive options, and assessment of threat. Propulsive options considered included; staged chemical, nuclear ablation and deflagration, mass driver and solar sail concepts. Trajectory tools plotted the outbound course to intercept the NE0 and the deflection requirements to cause the inbound NE0 to miss the earth. Threat assessment tools estimated the number of lives saved over a given time frame by deploying a system capable of deflecting an NE0 of a certain size and velocity. All of these tools were integrated into a routine to find the most effective vehicle for a given mission mass and mission time. Discussion of desired future efforts is given. This work was funded under the Revolutionary Aerospace Systems Concepts activity from NASA HQ.
Author
Near Earth Objects; Planetary Protection

20030066008 California Inst. of Tech., Pasadena, CA, USA
Martian Atmospheric Circulation and Climate
Ingersoll, Andrew P.; [2003]; 3 pp.; In English
Contract(s)/Grant(s): NAG5-9601; No Copyright; Avail: CASI; A01, Hardcopy

This proposal is focused on using Mars Global Surveyor (MGS) data and numerical models to address issues of atmospheric mixing of volatiles and aerosols, on defining the mean state of the atmosphere and the degree of variability, and on the processes which exchange volatiles and aerosols between the surface and atmosphere. Specifically, five areas of research were defined: In the first, we proposed to use TES data to examine the general circulation of the atmosphere both through retrieval of the residual circulation, and by comparison of the TES data with a Mars General Circulation Model (GCM). In the second, we proposed to look at synoptic and mesoscale atmospheric mixing processes (baroclinic storms, etc.) by combining TES and MOC Wide Angle data, and by employing a Mars Mesoscale Model. In the third section, we proposed to examine the record of the Martian atmospheric state provided by MGS, Viking, and Mariner 9 - as well as published ground-based observations - in order to assess the nature of interannual variability. In the forth section, we proposed to compare numerical models of the Martian water and dust cycles with TES and MOC data, specifically looking at water ice cloud distributions, dust distribution, etc. In the fifth section, we propose to use the mesoscale model to study the Mars Pathfinder Lander data. This work has now concluded its final of three years.
Author
Mars Atmosphere; Atmospheric Models; Atmospheric Circulation; Aerosols; Mesometeorology; Dust; Ice Clouds

20030066012 Lunar and Planetary Inst., Houston, TX, USA
Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter
2003; ISSN 0161-5297; 101 pp.; In English; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter, 12-14 Jun. 2003, Houston, TX, USA; See also 20030066013 - 20030066102
Contract(s)/Grant(s): NCC5-679
Report No.(s): LPI-Contrib-1163; Copyright; Avail: CASI; A06, Hardcopy

The papers presented at this conference primarily discuss instruments and techniques for conducting science on Jupiter's

icy moons, and geologic processes on the moons themselves. Remote sensing of satellites, cratering on satellites, and ice on the surface of Europa are given particular attention. Some papers discuss Jupiter's atmosphere, or exobiology.
CASI
Remote Sensing; Spacecraft Instruments; Icy Satellites; Jupiter Satellites; Planetary Geology

20030066014 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
A Brief Review of Infrared, Visible, and Ultraviolet Spectroscopy of Europa and Recommendations for the Jupiter Icy Moons Orbiter
Carlson, R. W.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 9; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper presents a review of infrared, visible and ultraviolet spectroscopic measurements of Europa. Recommendations are also given for the Jupiter Icy Moons Orbiter (JIMO) spacecraft.
CASI
Europa; Infrared Spectroscopy; Ultraviolet Spectroscopy; Spectral Emission; Visible Spectrum

20030066015 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany
High-Resolution Color Observations of Jovian Satellites
Denk, T.; Jaumann, R.; Wagner, R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 16; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Due to the limited downlink capabilities of the Galileo spacecraft, the amount of SSI color data (0.4-1.0 micron) from the icy Galilean satellites Europa, Ganymede, and Callisto is quite low. A global, low-resolution coverage (8- 34 km/pxl) exists only for Ganymede, while parts of Europa and Callisto have not at all been observed in multi-color by SSI. Several high-resolution color observations are available for Europa, and in a very limited number for Ganymede and Callisto. In terms of phase angle, the global color data are not homogeneous, nor do they span a variety of phase angles (over similar terrain) for spectrophotometry purposes. The outer Jovian satellites have never been studied by Galileo. Color data of the small inner moons exist, but suffer significantly from cosmic ray hits. For the icy Galilean satellites, common features are that short-wavelength reflectances (VLT filter, 0.4 micron) are always significantly lower than long-wavelength reflectances (1MC filter, 1.0 micron). For medium wavelengths (GRN filter, 0.6 micron), reflectances in between VLT and 1MC (causing homogeneously reddish spectra), or similar to the IMC values (implying the appearance of a 'violet-absorber material') are found both. Below, examples for Europa and Ganymede color properties are briefly described.
Derived from text
Galilean Satellites; Imaging Techniques; Remote Sensing; High Resolution; Spectral Reflectance; Imaging Spectrometers; Color

20030066016 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany
Galileo Stereo Imaging of Ganymede and Europa
Giese, B.; Oberst, J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 25; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

During the Galileo flybys of Ganymede and Europa, the onboard SSI camera acquired stereo images in local areas. These stereo images allowed us to reconstruct the surface topography in support of the geologic analysis. In this paper, we give an overview of the stereo target sites and show the results of topographic modeling for selected areas. We demonstrate that even under unfavorable conditions (stereo images were taken from different ranges, at different illumination, or from oblique viewing directions) stereo imaging is a powerful method to infer 3D information of the surface.
Derived from text
Europa; Ganymede; Imaging Techniques; Topography; Three Dimensional Models; Satellite Surfaces

20030066018 NASA Ames Research Center, Moffett Field, CA, USA
Callisto: A World in Its Own Right
Moore, Jeffrey M.; Schenk, Paul M.; McKinnon, William B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 55; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper presents a discussion on the planetary structure, evolution and composition of the Gallilean Satellite, Callisto. The Jupiter Icy Moons Orbiter (JIMO) mission is currently planned to first orbit Callisto then its two icy sisters Ganymede and Europa to investigate Callisto's actual configuration. The JIMO mission consists of three globally complete mapping sets

of Callisto along with spectrographic measurements to answer remaining outstanding questions about the geomorphology of Callisto.
CASI
Callisto; Geomorphology; Planetary Structure; Planetary Geology

20030066019 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Investigation Options for Atmospheric Science Using Near- and Middle-Infrared Instrumentation
Orton, G. S.; Yanamandra-Fisher, P. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 59; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper presents a discussion on scientific goals for Jupiter's atmosphere which include near and middle infrared remote sensing capabilities and high resolution spectroscopy.
CASI
Atmospheric Chemistry; Infrared Instruments; Jupiter Atmosphere; Near Infrared Radiation; Remote Sensing

20030066020 NASA Ames Research Center, Moffett Field, CA, USA
Impact Cratering: A Critical Jovian Icy Moons Science Objective
Schenk, P. M.; Moore, J. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 69; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Impact craters perform two vital functions in planetary history and evolution. They date the surface. They probe the interior. Voyager and Galileo based studies reveal that impact crater morphology is fundamentally different on icy and rocky bodies. Also, differences have been discovered among the icy satellites that are probably related to thermal state of the ice shell. Much of this is related to the strong temperature dependence of ice rheology on temperature, and the much weaker strength of ices in general. Depth diameter studies of impact craters show very clear breaks associated with morphologic transitions. In fact, some larger craters appear to be shallower than smaller craters. These transitions may be related to rheologic transitions at depth within the outer icy shells. Unfortunately, only a few of the larger impact craters can be mapped topographically and some of these were not observed at high resolution. It is therefore highly desirable to determine the shapes of larger impact features on these satellites.
Derived from text
Icy Satellites; Craters; Impact Damage; Satellite Surfaces; Planetary Mapping; Topography; Geomorphology; Models

20030066021 Laboratoire de Planetologie et Geodynamique, Nantes, France
Determining the Presence and Depth of an Ocean Within Europa, Ganymede and Callisto Using Gradiometers
Sotin, C.; Flokstra, J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 78; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

One of the main discoveries of the Galileo mission (and still unresolved question) about Jupiter's icy moons is the presence and depth of internal oceans. One way for determining the existence of an ocean is the measurement of gravity fields. To complement LoS measurements, we study how gradiometers could help in determining the existence of such oceans. Such devices are being developed to be used on future solar system exploration missions.
Derived from text
Galilean Satellites; Satellite Surfaces; Extraterrestrial Oceans; Gravity Gradiometers; Spacecraft Instruments; Gravitational Fields; Planetary Magnetic Fields

20030066022 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Measurement of Surface Composition for the Icy Galilean Moons Via Neutral and Ion Mass Spectrometry from Orbit with JIMO
Wong, M.; Berthelier, J.; Carlson, R.; Cooper, J.; Johnson, R.; Jurac, S.; Leblanc, F.; Shematovich, V.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 87; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

In this paper, we will provide insights into mass spectrometer requirements. In addition, we will describe the modeling of the neutrals ejected from likely surface materials and their ionization rates in the Jovian environment. We will use such models to connect the mass spectra measurements of the freshly formed ions to surface composition. We will also discuss what possible compositional signatures are for endogenic materials other than water ice. Finally, since a goal is to identify material

composition with surface features, we will describe the transport of neutrals ejected from the surface prior to detection by either an ion or neutral mass spectrometer.
Derived from text
Mass Spectroscopy; Jupiter (Planet); Surface Properties; Planetary Surfaces; Magnetometers; Planetary Geology

20030066023 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Scattering and Optical Properties of Water Ice
Yanamandra-Fisher, P. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 89; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Light scattering by planetary ices of interest such as water, methane, clathrated species, will provide insight into the nature of the Jovian moons targeted by the JIMO mission - Europa, Callisto and Ganymede - composition, surface properties and thickness of ice mantles. Although much remote sensing data exists, theoretical models lag the data. We highlight the current state of theoretical and experimental models for water ice and highlight areas of study necessary to address the JIMO goals regarding surface and subsurface properties.
Derived from text
Ice; Optical Properties; Light Scattering; Mathematical Models; Galilean Satellites; Satellite Surfaces

20030066024 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Radio Science Concepts and Approaches for Jupiter Icy Moons Orbiter
Anderson, J. D.; Asmar, S. W.; Castillo, J. C.; Folkner, W. M.; Konopliv, A. S.; Marouf, E. A.; Rappaport, N. J.; Schubert, G.; Spilker, T. R.; Tyler, G. L., et al.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 2; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Radio Science experiments have been conducted on most deep space missions leading to numerous scientific discoveries. A set of concepts and approaches are proposed for the Jupiter Icy Moons Orbiter (JIMO) to apply Radio Science tools to investigate the interior structures of the Galilean Satellites and address key questions on their thermal and dynamical evolution. Measurements are identified that utilize the spacecraft's telecommunication system. Additional instruments can augment these measurements in order to leverage observational synergies. Experiments are also offered for the purpose of investigating the atmospheres and surfaces of the satellites.
Author
Galilean Satellites; Planetary Geology; Spacecraft Instruments; Doppler Radar; Gravitational Fields; Gradiometers; Accelerometers; Radio Occultation

20030066027 Lockheed Martin Corp., USA
Small Craters and Surface Properties of the Icy Galilean Satellites
Bierhaus, E. E.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 6; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The JIMO Mission will revolutionize our understanding of impact-ejecta physics - and in doing so will reveal many physical surface properties of the icy Galilean Satellites, thereby enabling us to better parameterize ridge and chaos formation on Europa, the fault-structures on Ganymede, and the dark smooth unit of Callisto. To conduct this investigation, the JIMO mission should implement: (1) medium-resolution (10's to 100's m/pix) imaging of secondary craters fields around and extending from large impact craters, and (2) extensive very high resolution (a few m/pix) imaging of far-flung secondary crater fields. The moderate resolution images will enable mapping of the secondaries, matching specific clusters with their parent primary, while high-resolution images at chosen locales will enable detailed morphological studies of the secondaries as a function of increasing distance - and thus velocity - from the primary. These studies will provide both mass-velocity curves and information on surface properties.
Author
Craters; Satellite Surfaces; Galilean Satellites; Icy Satellites; Imagery

20030066028 Wheaton Coll., Norton, MA, USA
Toward a Global Understanding of Ganymede Tectonics
Collins, Geoffrey C.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 13; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

One of the major outstanding questions about the Jovian system, before and after the Galileo mission, is the origin of the

Ganymede-Callisto dichotomy, and the driving mechanism that created grooved terrain on Ganymede. Much of Ganymede's surface is dominated by tectonic deformation, which is virtually absent on Callisto. The Galileo mission has provided a possible clue to explain the divergent behavior between the two satellites, showing that Ganymede's interior is much more differentiated than Callisto. The origin of the interior dichotomy may involve differences in tidal heating or composition. The style, pattern, and sequence of tectonic activity on Ganymede is essential to our understanding of the overall evolution of the satellite, since it is a record of tidal and/or interior processes. For example, the interior differentiation of Ganymede can induce stress patterns on the surface which mimic those of orbital recession, but which are dominantly tensile. To determine whether the grooves on Ganymede actually constitute such a record, we need to determine the strain history of the surface. There are three steps to determining the strain history of Ganymede: (1) location and orientation of structures; (2) strain measurements; and (3) sequence of deformation.
Derived from text
Callisto; Ganymede; Satellite Surfaces; Planetary Geology; Tectonics; Deformation; Strain Measurement

20030066029 Search for Extraterrestrial Intelligence Inst., Moffett Field, CA, USA
Hydrates and Clathrates: Requirements for Spectroscopic Discrimination on Icy Moons
Dalton, J. B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 15; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Studies of the icy Galilean satellites require knowledge of composition to provide insights to rheology, chemistry, and influences of both endogenic and exogenic processes. The surfaces of these moons are postulated to contain many condensed volatiles, clathrates, radiolysis products and possible indicators of interior oceans such as hydrated salts. The unique capabilities of the JIMO spacecraft design may allow detection and robust discrimination of these materials by a properly designed and built spectrometer. The requirements for such an instrument can be determined by examining spectra of candidate materials. The controversy regarding interpretation of the Galileo Near-Infrared Imaging Spectrometer (NIMS) data can be traced to three primary causes: (1) the lack of laboratory spectra for most candidate materials, (2) the modest NIMS spectral resolution, and (3) the high spatial heterogeneity of these worlds. Laboratory spectra of candidate materials must be acquired at temperatures [80 - 150 K] relevant to the icy satellites, because spectral behavior for many compounds is temperature-dependent. To robustly identify a compound based on a single absorption, at least 3 channels must fall within the full width at half maximum (FWHM) of the absorption feature. Surface features imaged by the Galileo Solid State Imager (SSI) indicate that in order to measure discrete surface units, a spatial resolution of at least 100 m is necessary.
Derived from text
Galilean Satellites; Clathrates; Hydrates; Satellite Surfaces; Chemical Composition; Electromagnetic Spectra; Infrared Spectroscopy

20030066030 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Artificial Crater Formation on Satellite Surfaces Using an Orbiting Railgun
Dissly, R. W.; Miller, K. L.; Carlson, R. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 18; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The specification of greater than 45kW of disposable power available on the JIMO spacecraft raises the possibility of a new class of instrumentation that has utility at such power levels. In this presentation we discuss the concept of an electromagnetic mass driver that can launch projectiles from orbit around one of the Galilean satellites directed on a trajectory that will impact the satellite surface. The resulting impact will create a crater that will provide information on the mechanical properties of surface and near-surface materials, expose subsurface materials for remote spectral identification, and form a vapor cloud that can be sensed for composition either remotely or in-situ. An analog for such a controlled cratering experiment is Deep Impact, a mission to observe the crater and ensuing ejecta cloud formed by a ballistic projectile into a comet surface in July, 2005.
Derived from text
Craters; Satellite Surfaces; Galilean Satellites; Railgun Accelerators; Electromagnetic Acceleration; Systems Engineering

20030066031 Washington Univ., Saint Louis, MO, USA
Calibrating the Crater Production Curve Using Topographic Relaxation and How JIMO Can Help
Dombard, A. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 19; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Crater relaxation studies generally possess 2 unknowns: time and thermal state. Standard practice has been to use this

process as a thermal probe. That is, a crater's age is inferred by other means (usually crater counts), and relaxation is simulated in order to infer lithospheric thermal state. Here, the opposite is proposed: to assume thermal state in order to constrain crater age. By comparing these age assessments with those provided by crater counting statistics, an independent ground-truth of absolute age and the calibration of the crater production curve in the outer solar system is provided. Data returned by JIMO will be very valuable to this task.
Derived from text
Topography; Jupiter Satellites; Calibrating; Planetary Craters; Gas Giant Planets

20030066032 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Remote Radio Sounding Science for JIMO
Green, J. L.; Reinisch, B. W.; Song, P.; Fung, S. F.; Benson, R. F.; Taylor, W. W.; Cooper, J. F.; Garcia, L.; Gallagher, D.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 26; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Radio sounding of the Earth's top side ionosphere and magnetosphere is a proven technique from geospace missions such as the International Satellites for Ionospheric Studies (ISIS) and the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE). Application of this technique to the Jupiter Icy Moons Orbiter (JIMO) mission will provide unique remote sensing observations of the plasma and magnetic field environments, and the subsurface conductivities, of Europa, Ganymede, and Callisto. Spatial structures of ionospheric plasma above the moon surfaces vary in response to magnetic field perturbations from (1) magnetospheric plasma flows, (2) ionospheric currents from ionization of sputtered surface material, and (3) induced electric currents in salty subsurface oceans. Radio sounding at 3 kHz to 10 MHz can provide globally-determined electron densities necessary for the extraction of the oceanic current signals and supplements in-situ plasma and magnetic field measurements. Subsurface variations in conductivity, can be investigated by radio sounding from 10 MHz to 40 MHz allowing the determination of the presence of dense and solid-liquid phase boundaries associated with oceans and related structures in overlying ice crusts.
Derived from text
Satellite Sounding; Atmospheric Sounding; Satellite Atmospheres; Remote Sensing; Extraterrestrial Oceans; Electrical Properties; Magnetic Variations; Icy Satellites

20030066034 California Univ., Los Angeles, CA, USA
Dowsing for Water on Jupiter's Icy Satellites by Using a Magnetometer on JIMO
Khurana, K. K.; Kivelson, M. G.; Russell, C. T.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 39; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Many geophysical investigations suggest that Europa and Ganymede contain subsurface oceans. Using Jupiter's rotating magnetic field as a primary signal, the magnetometer experiment onboard Galileo measured secondary induction signals emanating from Europa, Ganymede and surprisingly Callisto. The strong electromagnetic induction from these moons suggests that large global electrical conductors are located just below their icy crusts. A detailed analysis reveals that global salty oceans with salinity similar to the Earth's Ocean thickness in the range of approximately 6-100 kms and depth in the range of a few tens of km can explain the induction observed near Europa. However, icy crusts thicker than 100 km are required to explain the magnetic data from Callisto and Ganymede.
Derived from text
Galilean Satellites; Extraterrestrial Oceans; Satellite Surfaces; Magnetic Signals; Magnetic Properties; Planetary Geology; Satellite Instruments

20030066035 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands
Rotating Electrodynamic Tether System for a Low-Weight Jovian Atmospheric Probe
Lebreton, J.-P.; vanderHeide, E. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 43; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

A concept based on a short rotating electro-dynamic tether system is being investigated as a means to deorbit a small Probe at Jupiter. Jupiter s strong magnetic field and relatively high plasma density makes the environment suitable for short electrodynamic tethers. Instead of relying on gravity gradient that would require a long tether to be effective, tether stability is accomplished by rotation. A bare tether concept with no plasma contactor is studied. The idea not to use a plasma contactor is not only reducing the hardware required, but also guarantees that the current and heat dissipation will not be excessive and can be dealt with in a practical manner with today s technology. On Jupiter, due to the high plasma density and strong magnetic

field, even without an active device to emit electrons, a significant current will flow, the circuit being closed by ion collection. The Lorentz drag force created can be sufficient to deorbit a low-mass atmospheric entry probe. The Lorentz force distribution and the resulting torque is such that, if given an initial rotation, this rotation will self-accelerate, thus keeping the tether taut through centrifugal force and stable through the gyroscopic effect. In this paper, the concept of the rotating tether is described and preliminary results of the study are presented.
Author
Jupiter Atmosphere; Electrodynamics; Probes; Low Weight; Rotation; Tethered Satellites

20030066036 Lockheed Martin Space Operations, Houston, TX, USA
A Large-Area Particle Sensor for Near-Earth Orbital Debris, Interplanetary Meteoroids, and Dust in the Jovian System
Liou, J.-C.; Matney, Mark; Stansbery, Gene; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 44; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

With the large vehicle size and payload capacity, increased power supply capability, and unique trajectory of the Jupiter Icy Moons Orbiter (JIMO), there is a great opportunity for a large-area particle sensor to sample near-Earth orbital debris, interplanetary meteoroids, dust in the Jovian system, and dust around the three Jovian icy moons. Our proposed instrument would accomplish several major scientific goals as well as provide an integrated environment definition (near Earth and inner Solar System) for the protection of future Project Prometheus (and other) missions.
Derived from text
Interplanetary Dust; Meteoroids; Solar System; Near Earth Objects; Space Debris; Jupiter (Planet)

20030066038 University Coll., London, UK
Measuring Europa's Shell Thickness and Surface Density Using JIMO-derived Gravity and Topography
Nummo, F.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 58; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

On silicate planets, analysis of satellite-derived gravity and topography in the frequency domain constrains the elastic thickness, crustal thickness, and near-surface density. In principle, this admittance technique could also be used on JIMO-derived data. Here, how these techniques could be applied, and the data requirements are discussed.
Derived from text
Europa; Topography; Planetary Geology; Planetary Crusts; Gravitation

20030066039 Search for Extraterrestrial Intelligence Inst., Mountain View, CA, USA
Methods for Detecting Current Geological Activity on Europa
Phillips, C. B.; Chyba, C. F.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 60; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Jupiter's satellite Europa could be the site of recent, or current, geological activity. Future missions to the Jovian system, such as the proposed Jupiter Icy Moons Orbiter, should search for evidence of such activity as a way to determine the potential for liquid water, and perhaps the astrobiological potential, of Europa. Searches for geological activity can include change detection, plume searches, thermal methods, and magnetospheric effects.
Derived from text
Europa; Planetary Geology; Satellite Surfaces; Change Detection; Plumes; Geothermal Anomalies; Magnetic Anomalies

20030066040 Instituto Nacional de Tecnica Aeroespacial, Torrejon de Ardoz, Spain
Fluorescence Biological Analysis (FBA) for the Astrobiology Exploration of Europa
Prieto-Ballesteros, O.; Gomez-Elvira, J.; Fernandez-Remolar, D.; Gomez, F.; Parro, V.; Amils, R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 61; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Astrobiology will be an important objective of the future JIMO mission, mainly focused on the satellite Europa due to the inferred presence of a harbor water ocean inside this satellite. From the Astrobiological exploration point of view, some Europan environments may be proposed taking into account parameters such as depth, physico-chemical characteristics and the available energy. The depth to the ocean is dependent of the geophysical structure of the icy crust, that is already under discussion, although it is mainly accepted to be between 5-30 km. A connection between the surface and the ocean by fracturing zones has been proposed. This could favor the cycle of some chemicals such as sulfur or the introduction of some

surface oxidants into the ocean. A saline composition for the Ocean has been argued from geochemical and geophysical models and from the observed chemistry of the surface. JIMO will explore the most accessible environment, which is the surface. We propose starting the astrobiological exploration of Europa with efficient techniques at low concentration of microorganisms, such as those based on fluorescence.
Derived from text
Bioassay; Fluorescence; Exobiology; Europa; Extraterrestrial Oceans; Chemical Composition; Satellite Surfaces

20030066041 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
High-powered Radar Sounders for the Investigation of Jupiter's Icy Moons
Safaeinili, A.; Rodriguez, E.; Edelstein, Wendy; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 66; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This talk will address the main drivers in the design of a radar sounder for the JIMO mission and provide a potential solution that will optimize the chances of success in the detection of ice/water interface and sub-surface stratigraphy.
Derived from text
Jupiter (Planet); Stratigraphy; Sounding; Icy Satellites; Planetary Geology; Multistatic Radar; Imaging Techniques

20030066042 Lunar and Planetary Inst., Houston, TX, USA
Topographic Mapping of the Jovian Icy Moons from Orbit
Schenk, P. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 68; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Few things clarify our understanding of planetary surfaces like a decent topographic map. The revolution in Martian geology wrought by MOLA is a classic example. Similarly, the scant topographic data being extracted from Galileo imaging are already pointing to unexpected discoveries for Callisto, Ganymede, and especially Europa. Although these data cover less than 25% of the surfaces of these satellites and are not controlled with respect to their centers of figure, they already address a host of geologic issues. They also hint as to what we may leam from a future dedicated satellite mission, and provide valuable constraints that will help design such missions, including landers.
Derived from text
Galilean Satellites; Satellite Surfaces; Planetary Mapping; Topography; Structural Properties (Geology); Imaging Techniques

20030066044 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Atmospheric Science and the JIMO Mission
Simon-Miller, A. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 75; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Jupiter Icy Moons Orbiter mission will intensely study Callisto, Ganymede and Eu- ropa for several years. During its orbital tour, there will be long periods (approximately 300 days) where the spacecraft is spiraling in from one satellite to the next, giving the perfect opportunity to study Jupiter's atmosphere. The obvious question is, 'Why do we need JIMO to do this, after Voyager, Galileo and the Cassini flyby?' Much like the satellite science from these missions, atmospheric science still has many outstanding questions, some of which were raised by these missions. In addition, virtually every measurable quantity on Jupiter varies both spatially and temporally, and previous missions did not supply the coverage needed to address them. The JIMO mission offers an outstanding opportunity for the global and long temporal coverage needed to answer these questions.
Derived from text
Jupiter Atmosphere; Atmospheric Chemistry; Atmospheric Physics; Spacecraft Instruments; Imaging Techniques; Remote Sensing; Multispectral Band Cameras

20030066045 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Io Science Opportunities with JIMO: Observing in the Infrared
Smythe, W. D.; Lopes, R.; Spencer, J. R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 77; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Jupiter Icy Moons Orbiter presents an opportunity to greatly improve our understanding of the most dynamic body in the solar system. Io is the best place to study tidal heating of the Galilean moons, provides unique insights into Earth history and is a unique laboratory for basic planetary physics. Many important questions about Io remain after Galileo that cannot be

addressed from Earth or Earth orbit, but could be answered by limited observing time from JIMO with the appropriate instrumentation. Here we outline the requirements in the infrared.
Derived from text
Io; Infrared Radiation; Heat Transmission; Satellite Surfaces; Surface Reactions; Chemical Reactions

20030066046 Lowell Observatory, Flagstaff, AZ, USA
Temperature Mapping of the Icy Galilean Satellites from JIMO
Spencer, J. R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 80; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The surface temperatures of the icy Galilean satellites provide unique information on volatile vapor pressures, chemical stability, cm-scale surface texture, and in the case of Europa, possible endogenic activity. JIMO provides an opportunity to map surface temperatures with unprecedented spatial resolution using mid-infrared thermal imaging.
Derived from text
Thermal Mapping; Galilean Satellites; Satellite Surfaces; Surface Temperature; Spacecraft Instruments; Imaging Techniques

20030066047 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Io Science Opportunities with JIMO: Ultraviolet and Visible
Spencer, J. R.; Lopes, R.; Smythe, W. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 81; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper presents a discussion on the Jupiter Icy Moons Orbiter (JIMO) mission to possibly study Io's spectacular time-variable phenomena from moderate range which was not achieved by Galileo, Voyager, or Earth-based studies.
CASI
Io; Ultraviolet Radiation; Jupiter Satellites; Jupiter (Planet); Planetary Geology; Light (Visible Radiation)

20030066048 Arizona Univ., Tucson, AZ, USA
The Importance of High-Resolution Topographic Data for Understanding Geologic Processes and Subsurface Properties of the Galilean Satellites
Turtle, E. P.; Showman, A. P.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 85; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

High-resolution (both vertical and spatial) topographic data, at global or regional scales, of the surfaces of the icy Galilean satellites would be immensely valuable to improving our understanding of geologic processes (both endogenic and exogenic) at work on these bodies. Furthremore, such a data set, in combination with theoretical models, would allow strong constraints to be placed on the satellites interior structures and material and thermal properties.
Derived from text
High Resolution; Imaging Techniques; Remote Sensing; Galilean Satellites; Satellite Surfaces; Planetary Geology; Ice

20030066049 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
An Examination of Issues Related to a Europa Subsurface Component for the JIMO Mission
Carsey, F. D.; Hecht, M. H.; Wilcox, B. H.; Behar, A. E.; Holland, P. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 10; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Galileo Europa data set served to revolutionize our view of Europa. In particular the strong evidence of a large, cold, salty Ocean beneath 5-30 km of ice has profoundly altered the significance of Europa in our thinking, especially of context of habitability in the solar system. While much remains to be learned from spacecraft observations of several sorts, there are significant questions answerable only by in-situ techniques; these relate to the formation of Europa, the nature of its ocean, and the prospects for life in its ocean, sediments, and ice. We feel that wide-ranging discussion of an in-situ subsurface mission to Europa, as part of JIMO, should proceed. The science objective of the mission is to characterize the icy shell of Europa to resolve its provenance, estimate the composition of brine of the Europa ocean, and search for evidence of Earth-like life. Probably anyone would agree that an in-situ mission to Europa would be of great value, but he or she would also immediately take the position that such a mission is utterly impractical. We take the position here of defining the least complex mission that can nonetheless justify its cost and to argue that such a mission is realistic enough that it should be seriously considered. Our mission thinking has been: 1) Soft landing. A soft lander is required on a site sufficiently flat to offer a stable platform; no further site selectivity is required. 2) Subsurface exploration. The Europa subsurface must be examined. Surficial processes on Europa arguably have exposed the upper 200 m of shell to chemical effects from the Jovian radiation belts as well as

cometary infall, etc; to examine native ice we must descend below that point to, for discussion, 300 m. At that depth we argue that the ice is characteristic of ice at depth and possibly is effectively sea ice. 3) Science data. A few simple measurements at various depths and at 300 m constitute a scientifically successful mission. Measurements would include analysis of meltwater for a few inorganic ions and amino acids and an optical examination of the borehole wall. 4) Communication. Transmission of data to an orbiter is essential, but we will constrain the landed mission to a daily communication over a few days. 5) Subsurface access. Drilling to 300 m is a significant challenge; it can be addressed by several means: Thermal Probe (Cryobot) which permits water to refreeze above the vehicle. This is our tentative choice with plutonium as the fuel to generate thermal energy for drilling and electrical power for operations. Open Hole Drill, a thermal system in which the meltwater is removed for greater thermal efficiency. Meltwater removal on Europa is both a complexity and a risk, but analysis is improved. Mechanical Drilling in which cutting or grinding generates ice chips which are removed. This is too complex at Europa temperatures. The measurement objectives for the mission will be: Obj. 1: Determine the concentration of simple inorganic salts in the Europa Ice Shell and, by extrapolation, of the ocean. These data will also validate spaceborne sensors. Obj. 2: Determine the nature and abundance of amino acids in the ice such that cometary infall material in the upper ice can be compared to material at depth. Obj. 3: Optically examine the ice to resolve inclusion structure, particulate content, and stratification. Access to 300 m depth is a significant if not audacious plan; we are aware that this has not been done on any planetary body. Our approach is the use of a plutonium heat source; to overcome Europa's surface temperature and to melt ice a significant amount of plutonium is needed, and significant shielding and other protective steps will be required. The quantity of plutonium is a key concern. The mission will require subsurface collection and processing of samples for in situ analysis, calling for a miniature, high pressure micro-sampling system designed to meet needs of instruments that require low presses for operation. The inlet system itself collects a micro-sample in the external high pressure environment, then transfers it into a protected low pressure environment for analysis.
Author
Europa; Extraterrestrial Oceans; Space Missions; Mission Planning

20030066051 Alaska Univ., Fairbanks, AK, USA
Salt Precipitation in the Europan Ice Shell and Its Potential Astrobiological Importance
Eicken, Hajo; Marion, Giles M.; Derning, Jody W.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 21; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The search for potential traces of life (i.e., dis solved and particulate biogenic compounds) on Europa's surface is facilitated by Ocean and ice turnover processes that are likely to disperse such tracers throughout most of the Europan ice shell. However, overall low expected concentrations of biomass and metabolic byproducts suggest that detection of relevant compounds may be hampered by detection limits of surface-based and remote techniques. This problem is compounded by the fact that ice formation processes typically result in exclusion of between 70 to >99 % of the total amount of dissolved material present in the parent water mass. In this context, a closer examination of the evolution and distribution of particulates (both on sub-decameter and planetary scales) may be of substantial value. Our studies of sea-ice bacterial activity at very low temperatures (down to approximately -20C) on Earth have shown that virtually all active cells at these low temperatures are particle-associated. Depending on the depth of salt precipitation horizons within the Europan ice cover and considering potential entrainment of particulates suspended in a Europan ocean, particle-rich regions on Europa's surface are hence more promising as target sites for a potential surface sampling mission. Furthermore, studies of the distribution of bacteria and other microorganisms in sea ice have also shown that the vast majority of cells resides within brine inclusions rather than in the solid ice matrix. The same holds true for potential biomarkers such as biogenic polymers and other metabolites. Under the Europan surface conditions any brine inclusions transferred to the surface through diapiric uprise or extrusion of warm ice or brine mobilization will have solidified into an aggregation of precipitates (and possibly associated ice particles). This process has been observed in sea ice samples in the lab, suggesting that any cells or dissolved material present would be trapped in a precipitate-ice matrix. In this presentation we will examine the implications of potential precipitation pathways and salt/ice microstructural evolution in the context of direct and remote analysis of the Europan surface ice layers as part of a future mission to the Jovian icy moons. Specifically, we will address the possibility of salt precipitation within the ocean and at various layers within the ice cover as well as discuss different processes of salt and particle entrainment that can substantially increase the concentration of potential biomarkers as compared to low background concentrations. Finally, the potential value and need for studies of Earth analogs in the context of future Europa missions will be discussed in the presentation.
Derived from text
Europa; Extraterrestrial Oceans; Organic Compounds; Biomarkers; Exobiology; Ice Formation; Precipitates; Microstructure; Surface Properties

20030066052 Atmospheric and Environmental Research, Inc., Lexington, MA, USA

Assessing the Impact of Regolith Structure on the Detectability of an Ocean on Europa by a Sounding Radar

Eluszkiewicz, J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 22; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The success of a sounding radar in detecting a subsurface ocean on Europa will depend on the density structure of Europa's regolith, as the extinction of the radar signal in the relatively clean Europan ice will be strongly influenced by the concentration of ice/pore/brine interfaces. The primary process affecting the density structure (and the closely-coupled thermal structure) of Europa's subsurface layers is self-gravitational compaction. As the depth of a porous regolith on an Europa-size icy satellite is likely to exceed 1 km, an investigation of compaction should be a high priority in assessing the range of possible measurement scenarios for JIMO radar and in their interpretation.

Author

Extraterrestrial Oceans; Europa; Satellite Sounding; Remote Sensing; Planetary Geology; Satellite Surfaces; Ice

20030066053 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Geology of the Icy Galilean Satellites: Understanding Crustal Processes and Geologic Histories Through the JIMO Mission

Figueredo, P. H.; Tanaka, K.; Senske, D.; Greeley, R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 23; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Knowledge of the geology, style and time history of crustal processes on the icy Galilean satellites is necessary to understanding how these bodies formed and evolved. Data from the Galileo mission have provided a basis for detailed geologic and geo- physical analysis. Due to constrained downlink, Galileo Solid State Imaging (SSI) data consisted of global coverage at a -1 km/pixel ground sampling and representative, widely spaced regional maps at -200 m/pixel. These two data sets provide a general means to extrapolate units identified at higher resolution to lower resolution data. A sampling of key sites at much higher resolution (10s of m/pixel) allows evaluation of processes on local scales. We are currently producing the first global geological map of Europa using Galileo global and regional-scale data. This work is demonstrating the necessity and utility of planet-wide contiguous image coverage at global, regional, and local scales.

Derived from text

Galilean Satellites; Icy Satellites; Satellite Surfaces; Planetary Geology; Imaging Techniques; Computer Aided Mapping; Planetary Mapping

20030066054 NASA Ames Research Center, Moffett Field, CA, USA

Life Detection: Mars and Beyond - A Summary as it Relates to JIMO

Flynn, M. T.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 24; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper provides a focused summary of the results of the Life Detection: Mars and Beyond workshop. Specifically, it addresses the Astrobiology derived science and technology requirements for the near and far term exploration of Europa. The stated objectives of the workshop was to examine potential technological focus areas for Astrobiology payload development and integration into future missions. The product was a set of recommendations concerning Astrobiology science objectives as they relate to Solar System exploration. In addition, recommendations were developed concerning how best to integrate emerging concepts and technologies for life detection into the design of a new generation of flight experiments for detecting life in other planetary environments. A primary focus of this workshop was to develop Astrobiology objectives for the exploration of Europa. As it relates to the exploration of Europa, the workshop resulted in a set of very specific recommendations which are relevant to the JIMO mission. The most significant of these is the need to incorporate a surface lander into the existing mission architecture. It was widely agreed that a JIMO mission with only an orbiter would generate limited interest and support from Astrobiology researchers.

Derived from text

Europa; Exobiology; Payload Integration; Payloads; Spaceborne Experiments; Extraterrestrial Life

20030066056 Washington Univ., Seattle, WA, USA

Ice and Non-Ice Properties of the Icy Galilean Satellite Surfaces from Infrared Spectra

Hansen, G. B.; Habbitts, C. A.; McCord, T. B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 28; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The first detailed near-infrared survey of the three icy Galilean satellites (Europa, Ganymede, and Callisto) of Jupiter was

undertaken by the Near-Infrared Mapping Spectrometer (NIMS) on the Galileo orbiter between 1996 and 2000. The first discoveries from this data were absorption bands in the 4-micron region, which is difficult or impossible to observe from Earth, that indicate the presence of CO2, SOX, C=N, C-H, and other materials. These bands occur on Ganymede and Callisto, and CO2 also appears on Europa. The 1-5 micron spectrum of these satellites is dominated, more or less, by the spectral features of water ice, including absorption bands at 1.04, 1.25, 1.5. and 2.0 micron, and a Fresnel reflection peak at 3.1 micron. At a spatial scale of many 10s of km, NIMS spectra almost always exhibited strong water ice features, but the spectra of the majority non-ice materials can be derived from the few ice-poor regions by modeling, if necessary, on all three satellites. On Europa and Ganymede, this non-ice material has asymmetric water bands near 1.4 and 1.9 micron, indicating a hydrated species. The analysis of NIMS data gives us only a tantalizing glimpse at sparse spatial and spectral sampling of what might be discovered by global mapping at a fine spatial scale that could be offered by the JIMO mission.
Derived from text
Icy Satellites; Galilean Satellites; Satellite Surfaces; Ice; Carbon Dioxide; Infrared Spectra; Chemical Composition

20030066057 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Europa Science Platforms and Kinetic Energy Probes
Hays, C. C.; Klein, G. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 30; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This presentation will outline a proposed mission for the Jupiter Icy Moons Orbiter (JIMO). The mission outlined will concentrate on an examination of Europa. Some of the primary science goals for the JIMO mission are: 1) to answer broad science questions, 2) improved knowledge of Jovian system; specifically, lunar geological and geophysical properties, 3) chemical composition of Jovian lunar surfaces and subterranean matter, and 4) the search for life. In order to address these issues, the experiment proposed here will deploy orbiting, surface, and subterranean science platforms.
Derived from text
Europa; Satellite Surfaces; Space Probes; Structural Design; Spacecraft Equipment; Chemical Composition; In Situ Measurement; Planetary Geology; Space Platforms

20030066058 Brown Univ., Providence, RI, USA
Global Geologic Mapping of Ganymede: Outstanding Questions and Candidate Contributions from JIMO
Head, J. W., III; Patterson, G. W.; Collins, G. C.; Pappalardo, R. T.; Prockter, L. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 31; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Voyager images of the surface of Ganymede were used to create geologic maps at 1:5 million scale and the variety and interpretation of units were a reflection of the viewing geometry and resolution of the images as well as the prevelant formation hypotheses of Ganymede at that time. Galileo high resolution imaging of the surface led to modification of many of these hypotheses and an advance in our understanding of the geology and history of this important Galilean satellite. A 1:15 million scale global map of Ganymede is being prepared to reflect these changes and to provide a post-Galileo global assessment of the geology and history. Many outstanding issues were identified by analysis of the Galileo data and the global mapping effort that could be resolved by a JIMO mission. We outline here some of the requirements for a mission such as JIMO and what types of scientific advancements this would bring.
Derived from text
Geological Surveys; Ganymede; Satellite Surfaces; Planetary Mapping; Imaging Techniques; Planetary Geology

20030066059 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
An Ultraviolet Imaging Spectrograph for JIMO
Hendrix, A. R.; Esposito, L. W.; Pryor, W. R.; Stewart, A. I. F.; McClintock, W. E.; Hansen, C. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 32; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

It is vital to include an ultraviolet spectrograph as part of the JIMO payload to Europa, Ganymede and Callisto. Ultraviolet measurements are key for understanding the atmospheres, auroral activity and surfaces of these icy satellites, and a UV imaging spectrograph will also complement a visible camera and near-IR spectrometer, to achieve full wavelength coverage in remote sensing of the icy satellites. The UV instrument proposed for JIMO will be similar to that currently on board the Cassini spacecraft. The design draws on the experience of building UV spectrometers for Mariner, Pioneer, Galileo and Cassini. It will have three spectrographic channels that provide images and spectra of the atmosphere, aurorae and surface:

An EUV channel (800-110 nm), an FUV channel (110 to 190 nm) range, and an NUV channel (180 to 350 nm).
Derived from text
Ultraviolet Spectrometers; Galilean Satellites; Satellite Atmospheres; Satellite Surfaces; Imaging Techniques; Remote Sensing

20030066061 Raytheon Missile Systems Co., Tucson, AZ, USA
Observational Selection Effects in Europa Image Data
Hoppa, G. V.; Greenberg, R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 34; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The identification of terrains on images of Europa is highly dependent on the image resolution and illumination angle, both of which are quite variable due to the observational selection constraints of both the Galileo and Voyager missions. In particular, theories for the formation of chaotic terrain have been influenced by observational selection effects within the Galileo data sets. Higher resolution images allow for the identification of smaller patches of chaotic terrain, which are indistinguishable from surrounding tectonic terrain in most other Galileo imagery. The incidence angle of light also introduces an observational bias in the identification of chaotic terrain: Images acquired closer to Europa's terminator generally reveal more chaos features than images taken with higher Sun. Proper accounting for selection effects has implications for the size distribution and chronology of chaotic terrain, and the geologic history of the satellite: At approximately 200 m/pixel 30% of Europa's surface appears as chaotic terrain, but with the effects of lighting and resolution taken into account, the portion is 40% or more; bias correction eliminates the 10-km-size peak that had been the basis of an earlier thick-ice model; 'mottled terrain' and 'lenticulae' appear to be the same as chaotic terrain, even though they have been mapped separately in the past; and accounting for how observational bias affects the freshness of appearance of chaotic terrain and the identification of tectonic modification of chaotic terrain demonstrates that the formation of tectonic and chaotic terrain have been concurrent processes throughout Europa's surface history. Similar observations selection effects can also be identified within Europa's tectonic terrain and the cratering record. Future mission planning for Europa imaging needs to consider strategies for minimizing and ameliorating observational selection effects on all of Europa's features in order properly allocate resources for the maximum scientific return.
Derived from text
Imaging Techniques; Europa; Satellite Surfaces; Image Resolution; Terrain Analysis; Image Analysis

20030066063 Geological Survey, Flagstaff, AZ, USA
Europa's Upper Crust and Ocean Compositions and the Ocean's Suitability as a Potential Habitat
Kargel, Jeffrey S.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 36; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

A scientific consensus exists that Europa may have an ocean, and most researchers believe it likely that an ocean exists there, still liquid, sustained by tidal heating, even today. Ocean of course conjures images, for scientist and layperson alike, of coral reefs and black smoker communities or at least primordial microbiological slime of one type or another. 'Where there's water there's life', it is often heard. It is NASA's theme for Mars and solar system exploration, and it extends to Europa, as well it should. However, life is not quite the corollary of ocean. Europa's ocean, if we assume that it exists, could offer some seriously difficult chemophysical challenges beyond the conceivable abilities of life to cope. In theory, Europa very possibly could have a cryogenic ocean of concentrated sulfuric acid solution where water is the minor component. At the other pH extreme, though we think this is improbable, the ocean could be a cryogenic eutectic ammonia-water ocean. Most likely, whatever the solute composition, solutes probably amount to roughly 6-10 or more times the molarity of Earth's seawater, and it is probably anywhere from a few kelvin to a few tens of kelvin colder than Arctic Ocean seawater. In composition it would make the Dead Sea look to humans like a benign environment. However, there are microbiological Earthlings who consider the Dead Sea to be ideal, and others who thrive best in sulfbric acid solution (though not the eutectic), and who consider the global ocean to be poison. It is certainly not our expertise to rule life out or in for Europa, but we will review several proposed alternative chemophysical models for Europa s ocean.
Derived from text
Extraterrestrial Oceans; Satellite Surfaces; Europa; Exobiology; Chemical Composition; Models; Planetary Geology

20030066064 Geological Survey, Flagstaff, AZ, USA
Orbit-based Geophysical and Geochemical Means to Detect Possible Transient Outburst/Eruptive Events (TOEs) on Europa's Surface or on Its Seafloor
Kargel, J. S.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 37; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Geophysical models and geological observations suggest that Europa's heat flow may be the second largest (after Io's) of all the objects in the Solar System. Even if tidal heating is an order of magnitude less than Io's heating rate, there exists a large chance that transient outburst/eruptive events (TOEs) may occur in any given terrestrial month of observations. Io's volcanic and volatile eruptive activity offers just a hint of what may occur on Europa's surface or seafloor. Large active silicate magmatic eruptions, sulfur dioxide or other volatile outbursts, or brine eruptions may occur during the period of orbital observations by the Jupiter Icy Moons Orbiter (JIMO). While any silicate eruptions would be confined to the seafloor, brine eruptions or outgassing events may occur either on the seafloor or onto the surface. Any large active TOEs, whether occurring on the seafloor or the surface of Europa, are apt to produce consequences that would be observable by a suitably instrumented JIMO. If a TOE represents a snapshot of a sustained localized phenomena, surface geological manifestations are likely. Here we focus on active TOEs, which may be geophysically or geochemically detectable as spatially confined data anomalies during overflights or by changes in repeat observations. A few possible detection methods are considered for the cases of (1) seafloor TOEs, including silicate eruptions, brine eruptions, and outgassing events, (2) brine eruptions onto the surface, and (3) outgassing events from the surface. All are assumed to be large events sufficient to give JIMO a TOEhold on Europa.
Derived from text
Europa; Satellite Surfaces; Remote Sensing; Detection; Planetary Geology; Geothermal Anomalies; Thermal Mapping; Imaging Techniques; Models

20030066065 Geological Survey, Flagstaff, AZ, USA
To Understand Europa We Must Investigate the Composition of Europa's Atmosphere and of Io's Emissions Inward of 9.5R(sub j)
Kargel, Jeffrey S.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 38; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Jupiter Icy Moons Orbiter (JIMO) incorporating Prometheus nuclear power and propulsion technologies offers an exciting opportunity to conduct detailed studies of Europa's icy surface and ice-covered ocean as well as exploration of Ganymede and Callisto. While the prime mission is well defined and warranted to be confined to the icy moons, full understanding of Europa requires an examination, if at all possible, of the composition of Io's volcanic and surface emissions. Io's emissions dominate the plasma composition of the overall Jovian system, and it may or may not dominate close to Europa. There is a need to look at the magnetospheric plasma and neutral matter close to Europa (from Europa orbit and approach to orbit) and in Jupiter orbit space both inside and outside of Europa's orbit. This could be possible by use of sensitive neutral mass spectroscopy (NMS) and ion mass spectroscopy (IMS), which would also find general use in studies of the other satellites and of the Jovian magnetospheric plasma environment. The NMS/IMS technology must make measurements significantly inward of 9.5 R(sub J), perhaps during an extended mission, to resolve an unambiguous signature of Io's charged emissions from those originating on Europa. We will present some likely geochemical signals of Europa and Io, the implications of these signals for endogenic processes, and how these signals and their implications could become confused lacking a clear resolution of the two objects emissions. The JIMO instrument payload and mission design should not preclude, if possible, studies of the Io torus either during approach to Europa or afterward during a potential extended mission journey to Io, as well as of the tenuous Europa extended atmosphere. Any NMS/IMS capability should look at very low-mass elements to fairly heavy minor/trace components (at least from H to Ni, preferably to Sr or even Xe). The payload should be capable of resolving isotopic masses of H, S, O, and noble gases. Lacking any observations made inside Europa's s orbit, any signals associated with Europa will be difficult to resolve clearly from possible outflow from Io or even outflow from Europa due to implanted Iogenic material.
Derived from text
Europa; Satellite Atmospheres; Io; Instrument Packages; Payloads; Plasma Composition; Planetary Atmospheres; Magnetic Signatures; Chemical Analysis

20030066068 California Univ., Berkeley, CA, USA
The Search for Life on Europa: Jupiter Icy Moons Orbiter Objectives
Lipps, Jere H.; Pehl, Curtis; Rieboldt, Sarah; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 45; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

On Europa, present and past life preserved in the icy crust might be abundant and varied. Indeed, analogous icy habitats on Earth suggest that many opportunities for life and ecosystem development are possible on Europa. Possible habitats include benthic soft and rocky substrates on the ocean's floor, pelagic ones in the water column, and cryophilic types in various ecologic settings in the ice cover itself. These habitats have potential for transportation to and preservation at the surface of Europa, thus making them accessible to a surface sampler. Surface sites that might contain life or fossils include the areas of

refrozen ocean, chaotic terrains, the ridges and rills associated with fissures, low areas where water may have collected, and dirty ice that may include benthic material floated to the surface by bottom anchor ice or gouged by ice, as well as the variety of ice habitats. Because the ice on Europa varies in age and a stratigraphy can be reconstructed, evolutionary patterns of life may also be sampled. Thus, a sampling strategy for life and its history on Europa should include paleontological and molecular biological objectives that would clearly document the present and former existence of life on Europa. The strategy should include pre-landing study of probable preserved or extant ice habitats, followed by robotic landers equipped to sample surface materials and image them after appropriate processing. The Jupiter Icy Moons Orbiter and possible associated lander should obtain high resolution images, laser altimeter mapping, chemical analysis of materials, radar penetration of specific sites in likely areas where life might be preserved. These will allow detailed analysis of the geology and structure of the ice to determine the potential for a successful search for life. Objectives for a lander should include the ability to land in rough terrains, to roam 10's to 100's of kms, to traverse steep slopes, to withstand chemical and radiation attack, and to sample to depths greater than one meter. These objectives present engineering challenges and vision for the construction of a lander that will require new approaches to locomotion, power, command, specimen acquisition and analysis, and data processing at Europa.
Derived from text
Europa; Satellite Surfaces; Ice; Exobiology; Space Probes; Planetary Geology; Mission Planning; Extraterrestrial Life

20030066072 Johns Hopkins Univ., Laurel, MD, USA
Science and Payload Drivers for the Jupiter Icy Moons Orbiter (JIMO)
McNutt, R. L., Jr.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 54; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Primary science goals of a mission to the outer three Galilean satellites include the deduction of internal structure and the possible presence of liquid water beneath the ice crusts of these worlds. Ganymede has shown evidence of a magnetic field driven by a dynamo, while the presence of a substantial amount of liquid water on Europa has been inferred from the presence of a large-scale induced magnetic field. A liquid-water mantle can provide an explanation of the magnetic characteristics of these moons and also provide a possible site for biological activity, but major unknowns include the possible extent and composition of a sub-surface brine sea. Using the power resources available on the Jupiter Icy Moons Orbiter (JIMO) spacecraft critical data on all of these topics can be returned to Earth. A comprehensive payload requires a radar sounder, laser altimeter, and a suite of fields and particles instruments.
Derived from text
Satellite Instruments; Instrument Packages; Laser Altimeters; Satellite Sounding; Galilean Satellites; Satellite Surfaces; Ice; Payloads; Extraterrestrial Oceans

20030066073 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Radiation Synthesis of New Molecules on Jupiter's Icy Satellites
Moore, M. H.; Hudson, R. L.; Carlson, R. W.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 56; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Spectra of Jupiter's icy satellites reveal surfaces dominated by water-ice, minor amounts of SO2 and CO2, and (for Europa) H2O2 along with hydrated materials. Jovian magnetospheric ions (protons, sulfur, and oxygen) and electrons significantly modify the chemical composition of these moons' surfaces in times ranging from a few years for Europa to thousands of years for Callisto at micrometer depths. Appropriate laboratory studies examining relevant volatile and non-volatile materials under low-temperature radiation conditions can provide information on likely radiation chemical mechanisms, on the stability and evolution of species, and on new species awaiting detection. Although the molecules detected on the icy moons are relatively simple, predicting their responses to radiation in space remains difficult. One problem is that there is a dearth of fundamental data examining solid-phase reactions. Our laboratory experiments have focused on infrared studies (2.5 to 25 microns) of a few simple irradiated ices. We have measured the spectra of proton-irradiated H2O ice containing SO2, H2S, and/or CO2. Ices with H2O/SO2 or H2O/H2S ratios of 3 and 30 have been irradiated at 86 K, 110 K, and 132 K. In irradiated H2O + SO2 ices new ions have been identified: SO4(-2), HSO4(-) and H3O(+). After warming to 260 K the residual spectrum is similar to that of H2SO4. Ices with H2O + H2S form SO2. After warming to 175 K, the residual sample matches the spectrum of hydrated H2SO4. H2O + CO2 ice forms carbonic acid, H2CO3 which is stable to temperatures near 230 K. In addition, OCS has been detected in irradiated ices containing H2O + SO2 + CO2. The radiation half-life of SO2 and H2S in H2O has been calculated. Our results give compelling evidence for the presence of new species awaiting detection. Future experiments will examine the signatures of these ices and hydrated materials in the 1 to 5 micron region, where possible weaker overtone bands may occur. In addition, absolute strengths for both the fundamental and

overtone bands will be determined. Finally, good arguments can be made, based on current information, for remote sensing observations that have spectral coverage to at least 5 microns on the long wavelength end. This range would include some of the characteristic bands of H2O, H2O2, CO2, SO2, H2CO3, H2S, and OCS.
Author
Icy Satellites; Infrared Radiation; Jupiter Satellites; Molecules; Synthesis (Chemistry); Jupiter (Planet)

20030066074 California Univ., Los Angeles, CA, USA
The Tidal Response of Ganymede and Callisto With and Without Liquid Water Oceans
Moore, W. B.; Schubert, G.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 57; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

It has been proposed that a measurement of the amplitude of the tidal deformation of Europa would allow confirmation of the existence of a global liquid Ocean beneath the ice [Moore and Schubert(2000), Wu et a1.(2001)]. With an Ocean that decouples the surface ice from the rocky interior, the amplitude of the semi-diurnal tide on Europa is roughly 30 m, vs. approximately 1 m in the absence of an ocean. This signature would be observable from orbit by measuring the time-dependent gravity and topography over the course of several Europan days. The accuracy of a tidal amplitude determination would depend mostly on the amount of time spent in orbit and the ability to revisit the same points on the surface allowing crossovers to constrain the spacecraft orbit. This technique has been used with the Mars Global Surveyor spacecraft to measure seasonal variations in the topography of Mars with amplitudes as small as approximately 10 cm over the course of slightly more than a Martian year. Due to the shorter period of tidal variations at Ganymede and Callisto, a mission lasting a few months could sample many tidal cycles, thus greatly improving the signal strength. In order to determine if an experiment with approximately 10 cm accuracy could identify the tidal signature of liquid Oceans at Ganymede and/or Callisto, models of the tidal response of these bodies have been constructed.
Derived from text
Callisto; Extraterrestrial Oceans; Ganymede; Tides; Topography; Geophysics

20030066075 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Geophysical Probes of the Icy Satellites of Jupiter
Banerdt, W. B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 4; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

This paper presents a discussion on the structure and dynamic processes of the interiors of the icy satellites of Jupiter. Although such measurements as global gravity and magnetic fields, high precision altimetry and radar sounding can be made from the Jupiter Icy Moons Orbiter (JIMO) satellite, there are certain seismic and heat flow measurements which must be made from the surface to clearly understand the geophysics of a planet such as Jupiter. The possibility of a geophysical probe that can be released into orbit about a satellite to return potential field data for a sufficient period of time is discussed.
CASI
Geophysics; Icy Satellites; Jupiter Satellites; Planetary Evolution; Probes; Gravitational Fields

20030066076 Raytheon Co., Santa Barbara, CA, USA
Advanced Mapping Imager for the JIMO Mission
Blasius, K. R.; Chrien, T. G.; Silverman, S. H.; Schueler, C. S.; Puschell, J. J.; Greenfield, M. J.; Dykerman, D. A.; Wang. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 8; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

NASA has developed recent technologies for a low risk but highly capable mapping imager for the Jupiter Icy Moons Orbiter (JIMO). The optical, spectral dispersion, and detector technologies are presented.
CASI
Detectors; Jupiter (Planet); Planetary Geology; Planetary Mapping; Imaging Spectrometers

20030066077 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Jupiter Atmospheric Science with JIMO: Linking Science Objectives and Measurement Goals
Chanover, N. J.; Glenar, D. A.; Simon-Miller, A. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 11; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Although the primary focus of the Jupiter Icy Moons Orbiter (JIMO) mission will be the characterization and study of

Jupiter's icy moons, there will be opportunities throughout the mission for unprecendented observations of Jupiter. With an adaptable suite of payload instruments, the atmospheric data collected by JIMO can help to answer fundamental questions about the largest planet in our solar system that remain after (or were generated by) previous spacecraft reconnaissance (e.g. Voyager, Galileo, and Cassini). Near-IR (0.7-4 micron) spectral imaging will most likely be used to identify mineralogies and ices on the Jovian satellites by virtue of their spectral signatures. This same capability is very well tailored for studies of Jovian atmospheric dynamics and structure. Near-IR methane absorption bands allow 2-D mapping of the horizontal wind field at size scales to tens of kms, as well as the height dependence of this field above the ammonia cloud deck (700 to a few mbar), constraining current models of atmospheric vertical structure. Likewise, atmospheric ice aerosols with unique spectroscopic signatures (ammonia ice near 1.5, 2.0, and 2.8 microns and water ice between 3.0 - 3.5 microns) can be detected and mapped using spectral difference imaging or spectrally inclusive principal-component methods. Spectral imaging of the Jovian aurora via (3)H(+) emission lines between 3 - 4 microns can be used to spatially map the interplay between the satellites) Jupiter's magnetosphere, and Jupiter's atmosphere. Each of these measurements addresses one or more fundamental questions related to the energy balance in Jupiter's atmosphere. All of these tunable imaging objectives can be achieved using acousto-optic tunable filters (AOTF's), which have been used for years in ground-based observing instruments and which have been proposed for numerous planetary missions. The application of this technology to the science objectives of both the icy satellites and Jovian atmospheric components of the JIMO mission will be discussed.
Author
Jupiter Atmosphere; Planetary Meteorology; Spacecraft Instruments; Imaging Techniques; Astronomical Spectroscopy; Atmospheric Chemistry; Atmospheric Physics

20030066078 Southwest Research Inst., Boulder, CO, USA
Studies of Cratering on Jupiter's Icy Moons
Chapman, C. R.; Merline, W. J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 12; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The surfaces of Callisto, Ganymede, and Europa all exhibit impact craters as well as some other features that masquerade as craters. Data from the Galileo mission demonstrate a wide diversity of crater populations, reflecting the competition between crater-forming processes and crater degradational processes. Numerous issues have been raised by the Galileo studies, pertinent to understanding the histones of the surfaces of these bodies as well as the sub-surface character of their crusts. Due to downlink limitations, Galileo imaging could only whet our appetites for additional definitive data sets that could permit a comprehensive investigation of what the Galilean satellite crater populations might tell us. Remote sensing observations of the satellite surfaces, using techniques analogous to what MOC and THEMIS are now accomplishing for Mars, is an essential ingredient of the JIMO mission, and analysis of impact cratering from those images will provide a fundamental underpinning for inferring the geological histories and crustal structures of those bodies.
Derived from text
Galilean Satellites; Satellite Surfaces; Craters; Cratering; Planetary Geology; Planetary Crusts

20030066079 Southwest Research Inst., San Antonio, TX, USA
Core Plasma Measurements for the Jupiter Icy Moons Orbiter
Crary, F. J.; Young, D. T.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 14; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Jupiter Icy Moons Orbiter (JIMO) will provide an exciting opportunity to study the dynamics of the magnetospheres of Jupiter and Ganymede, and the interactions between Callisto, Europa and Jupiter's magnetosphere. We will discuss some of potential observations and the role of a core plasma spectrometer (measuring ions and electrons between approximately 1 eV - 50 keV) in the context of the JIMO mission, and the ability of such an instrument to operate on a spacecraft using electric propulsion.
Derived from text
Planetary Magnetospheres; Satellite Atmospheres; Spectrometers; Callisto; Europa; Ganymede; Magnetic Disturbances; Planetary Magnetic Fields; Planetary Ionospheres; Jupiter Atmosphere; Plasmas (Physics)

20030066080 Johns Hopkins Univ., Laurel, MD, USA
Diagnosing Interactions Between Jovian Satellites and Their Energetic Charged and Neutral Particle Environments
Mauk, B. H.; Paranicas, C. P.; Cooper, J. F.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 49; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We review Galileo and Cassini findings regarding the character and dynamics of energetic (> 20 keV) charged ion and electron environments of Europa, Ganymede, and Callisto; and regarding energetic neutral atom (ENA) emissions from the Europa environment. We document the value of energetic particle measurements in diagnosing the geometry and topology of the near-satellite space/surface interaction regions, knowledge that is vital to interpreting magnetic and electric signatures of satellite internal structures. We review what is known about the distributions and effects of direct energetic particle impacts on satellite surfaces, and what is known about the deposition and removal of materials by those interactions. Finally, we discuss the value of the new ENA techniques in (1) directly imaging the distribution of interactions between sparse satellite atmospheres (and associate surfaces) and energetic ions, and (2) determining the distributions of neutral gases emitted from the satellites, particularly Europa. We end with recommendations regarding energetic particle and ENA instrumentation for the Jupiter Icy Moons Orbiter.
Derived from text
Galilean Satellites; Satellite Atmospheres; Satellite Surfaces; Energetic Particles; Plasma-Particle Interactions; Charge Exchange; Plasmas (Physics)

20030066082 Washington Univ., Saint Louis, MO, USA
Internal Structures of the Galilean Satellites: Unfinished Business and the Road Ahead
McKinnon, William B.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 53; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Among the real highlights of the Galileo mission were the first formal constraints on the internal configurations of the Galilean satellites, mainly from gravity data but augmented beautifully by detection of both internal and induced magnetic fields. Because there were many satellite passes during the multiply-extended mission, gravity fields could be reliably determined out to degree two, which allowed determination of satellite moments-of-inertia provided the satellites were in hydrostatic equilibrium. This latter assumption is not necessarily secure, however, due to incomplete gravity coverage. Orbital missions provide the potential to reliably determine satellite moments-of-inertia plus evaluate the role (if any) of non-hydrostatic contributions. These nonhydrostatic contributions in turn provide windows into regional interior processes of great interest (such as suboceanic volcanic loads on Europa).
Derived from text
Galilean Satellites; Planetary Geology; Moments Of Inertia; Gravitational Fields; Magnetohydrodynamic Stability; Plasma Equilibrium; Models

20030066084 Raytheon Co., Goleta, CA, USA
Multifunctional Active-Passive Millimeter Wavelength Imager-Sounder for the JIMO Mission
Puschell, J. J.; Blasius, K. R.; Jack, M.; Silverman, S. H.; Schueler, C. S.; Greenfield, M. J.; Dykeman, D. A.; Wang, J.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 63; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Raytheon recently developed microbolometer arrays that are suitable for operation in the approximately 125-300 GHz frequency region. These early development (TRL 4) arrays are currently available in a 32x32 format size, which can be, readily increased to 64x64 and beyond. The bowtie structure shown is a microbolometer-antenna combination. Our initial performance projections for radiometric sensitivity and spatial sampling are encouraging and suggest this technology, when coupled with a tunable Fabry-Perot interferometer, can enable relatively large format millimeter wavelength imager-sounders for the JUpiter Icy Moons Orbiter (JIMO) mission. We suggest this millimeter wavelength imaging spectrometer be incorporated into a multifunctional active-passive RF system that would also include an imaging radar. This flexible, multi-functional system would provide data to address a wide variety of critical science investigations including presence of subsurface water on these icy moons, detailed high resolution imaging of molecular features and millimeter wavelength continuum on the surfaces and in extended atmospheres of Jupiter and its moons.
Derived from text
Imaging Spectrometers; Jupiter Atmosphere; Millimeter Waves; Jupiter Satellites; Bolometers; Antenna Arrays

20030066085 Southwest Research Inst., San Antonio, TX, USA
Prospects for FUV Remote Sensing of Io's Atmosphere and Magnetospheric Interaction with JIMO
Retherford, K. D.; Gladstone, G. R.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 64; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

We will discuss how FUV remote sensing provides valuable information regarding Io s atmosphere, its interaction with

magnetospheric plasma, and its volatile evolution, which demonstrates a UV spectrograph should be included as part of the JIMO mission. Information provided by FUV spectral imaging of Io's auroral O and S with the STIS spectrograph on the Hubble Space Telescope will be briefly reviewed. Important measurements that require a UV spectrograph will be discussed, along with various observing techniques. Lastly, potential UV observations of other Jovian system targets such as satellite footprint aurorae on Jupiter and the Io plasma torus will be mentioned.
Derived from text
Imaging Techniques; Io; Remote Sensing; Far Ultraviolet Radiation; Jupiter Atmosphere; Planetary Magnetospheres

20030066086 Jet Propulsion Lab., California Inst. of Tech., Wrightwood, CA, USA
Decimeter-Wavelength Polarimetric Radar Imaging of the Icy Moons of Jupiter
Rosen, P. A.; Gurrola, E. M.; Madsen, S. N.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 65; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Imaging radars with wavelengths in the range of 10 cm to 1 m can deeply penetrate the surface of an icy body, revealing details of the geomorphology, local structure, and electrical properties of the upper layers. Radar studies of icy surfaces on Earth have used the polarization state of backscatter echoes at multiple frequencies to characterize the surface and subsurface properties of glaciers, showing relatively smooth surfaces on the scale of radar wave-lengths, and subsurface scattering from volume scatterers consistent with ice pipes and lenses. These volume scattering effects are evident in enhanced polarization ratios over a limited range of backscatter incidence angles. The Galilean satellites exhibit similarly enhanced polarization ratios and volumetric scattering effects, but the observations are limited in angular resolution, leading to ambiguity in interpreting the scattering mechanisms and their structural implications.
Derived from text
Galilean Satellites; Ground Penetrating Radar; Planetary Mapping; Satellite Surfaces; Surface Properties; Polarization (Waves); Imaging Radar; Ice; Radar Resolution

20030066087 Johns Hopkins Univ., Laurel, MD, USA
Diagnostic Magnetospheric Parameters for Probing Icy Satellites' Interiors
Saur, J.; Mauk, B. H.; Paranicas, C. P.; Neubauer, F. M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 67; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We discuss in this presentation observational quantities which are well suited to monitor properties of the icy satellites interiors and their plasma interactions with Jupiter's magnetosphere. A primary goal of a mission to the icy satellites is to establish or rule out the existence of subsurface oceans. We show that measurements of the magnetic and electric fields close to the satellites represent a great diagnostic tool to probe the present status of the satellites interiors [Neubauer, 1998, Khurana et al. 1998]. However plasma interactions between Jupiter s magnetosphere and the satellites atmospheres strongly obscure these internal signatures. Therefore it is essential to have reliable models of the plasma interactions. In our presentation we hence first discuss the primary signatures of the satellites interiors on external magnetic and electric fields and then present our models of the plasma interactions [based on, Saur et al., 1998]. We point out that in order to better separate interior and exterior effects, a JIMO low altitude orbit and a full 4pi coverage is preferable. We also discuss that independent observations of the plasma interactions by monitoring of the UV emission from the satellites atmosphere/ionosphere will be a supplemental diagnostic tool. Satellites UV emissions probe content, structure, and composition of the Satellites atmospheres, but the UV emissions also probe simultaneously the electro- dynamic interactions via the strong UV dependence on electron densities and temperature. During JIMO s approach to the icy satellites a long term study and gauging of the plasma interactions could take place including a study of their system III (longitudinal) dependences. Finally, our presentation will show that a maximum science return of the JIMO mission will be gained by interdisciplinary work among the different science categories, such as magnetospheric environment, interior structures, atmospheres and surface chemistry and geophysics.
Author
Geophysics; Icy Satellites; Planetary Magnetospheres; Jupiter (Planet); Jupiter Atmosphere

20030066088 Lockheed Martin Advanced Technology Center, Palo Alto, CA, USA
Jovian Energetic-Particle Measurements and X-Ray Images
Schulz, M.; Fuselier, S. A.; Mobilia, J.; Magoncelli, A. L.; Gaines, E. E.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 70; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Our group contemplates combining the simultaneous measurement of energetic particle fluxes (electrons up to 30 MeV, protons and other identifiable ions up to 200 MeV) with global imaging of X-rays (2- 60 keV) from Jupiter and its icy moons. Our prototype for the X-ray imager is PIXIE, on NASA's Earth-orbiting Polar satellite. Bombardment of Jupiter's atmosphere by energetic electrons is likely to produce X-ray signatures complementary to already observed optical auroras on magnetic shells corresponding to Jupiter's Galilean satellites. X-ray spectra reveal characteristics of the precipitating electron distribution, hence (for example) the amount by which electrons are energized by any parallel potential drops associated with the corresponding electrical circuits. X-rays produced by electron bombardment of the Galilean satellites themselves can be imaged with the same instrument. Such remote measurements with an onboard X- ray imager thus complement in situ measurements of energetic charged-particle fluxes over a broad range of energies.
Derived from text
Spacecraft Instruments; X Ray Imagery; Particle Flux Density; Measuring Instruments; Galilean Satellites; Jupiter Atmosphere

20030066089 Texas Univ., El Paso, TX, USA
Putative Biospheres for Europa and Ganymede: Modeling and Biosignature Detection
Schulze-Makuch, D.; Irwin, L. N.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 71; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

We have calculated the theortical biomass of potential ecosystems of Europa and Ganymede, assuming the presence of a liquid ocean beneath the frozen surface, and three trophic levels analogous to marine ecosystems on Earth. Our models are based on chemo-autotrophic producers with the metabolic requirements of yeast cells that derive their energy from the oxidation of hydrogen outgassed from the mantle. Making reasonable assumptions about hydrogen availability, adjusted for planetary size, we calculate that a 100 m-thick shell of water at the mantel/ocean interface could contain multicellular consumers with an organismic masss of 1 g (the size of a small goldfish) in a volume of ocean measuring 43,000 cu m on Europa and 2200 cu km on Ganymede.
Derived from text
Europa; Ganymede; Ecosystems; Extraterrestrial Oceans; Models; Biomass; Signatures; Biomarkers

20030066091 Stanford Univ., Moffett Field, CA, USA
Jovian Ring Science Opportunities with the JIMO Mission
Showalter, M. R.; Hamilton, D. P.; Burns, J. A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 74; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Jupiter's ring system consists of four components: a main band approximately 6000 km wide, a vertically-extended inner halo, and a pair of exterior gossamer rings. Each component illustrates aspects of dust dynamics within Jupiter's inclined magnetic field and its strong inner plasma environment. The rings are also intimately tied to the four inner moons Metis, Adrastea, Amalthea and Thebe, which define the outer edges of three components and serve as major source bodies for the visible dust. Although the rings have been examined by four spacecraft and from Earth, we are still lacking a systematic data set showing them with sufficient resolution and sensitivity to make dynamical sense of many ring structures. More complete coverage in phase angle and wavelength is needed to determine the properties of the dust grains and embedded source bodies, and to understand the interactions between these two populations. With better understanding of the processes at work, the rings can serve as a probe of the innermost magnetosphere (1-3 R(sub j)), where spacecraft cannot travel safely.
Derived from text
Jupiter Rings; Jupiter Atmosphere; Planetary Magnetic Fields; Plasmas (Physics); Cosmic Dust; Magnetic Properties; Electromagnetic Properties

20030066092 Observatoire de Midi-Pyrenees, Toulouse, France
Probing the Internal Structures of the Galilean Satellites with a Complement of Geophysics Investigations
Blanc, M.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 7; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Galilean satellites are fascinating worlds, whose in-depth exploration will change deeply our understanding of 'terrestrial' planets by showing how they have formed and evolved in the cold fraction of the solar nebula, in much the same way as the discovery of 'hot Jupiters' around near-by stars durably changed our view of giant planets themselves. The JIMO mission will be a unique opportunity to establish the basic elements of the internal structure of these icy bodies. These elements are critical in the response to two outstanding questions : the existence of subsurface oceans, and the extent, physical

properties and dynamics of a core possibly responsible for the generation of the intrinsic field (in the case of Ganymede). Both questions have a strong impact on astrobiology. But this will require a strategy combining in a complementary way the measurement of the fundamental planetary fields (magnetic field, gravity field field, surface topography) with a set of sounding techniques (low frequency electromagnetic sounding, seismology, ground-penetrating radar). This strategy, though complex, can be developed in the framework of JIMO as a consequence of its extended energy source and payload mass capabilities. We shall describe the main elements of such a comprehensive approach. It will combine investigations on board of the main spacecraft or of subsatellites with a few critical elements which should deployed on the surface of at least one of the icy bodies via a (probably hard) lander. On board of the main craft, one should conduct the following investigatons: a ground penetrating radar for the probing of the outermost layers of ice and possibly of an ocean; a laser altimeter for the determination of the surface topography of all three satellites; a three-axis magnetometer for the determination of the magnetic field. Combined with an appropriate plasmas and fields package, and with a clever coverage of altitudes and latitudes, it should make it possible to separate the external, internal induced, and internal permanent components of the field, providing constraints both on the internal structure and on the diversity of plasma interactions developed at the three Galilean satellites; A gravimetry or radio science experiment for the determination of the gravity field. A hard lander should be designed in parallel to deliver to the surface of at least one of the three satellites a package carrying the following elements: a seismometer, a very basic element for the determination of the internal structure, knowing that the seismic signal should be usable; a magnetometer which will play an important role in the separation of the internal and external components of the magnetic field and the subsequent use of the induced component for the determination of the internal structure; a radio science experiment which will, among other elements, determine the proper motions and deformations (tidal motions, librations etc.) of the solid body. We shall develop this strategy in more detail during the workshop presentation.
Author
Galilean Satellites; Planetary Geology; Structural Properties (Geology); Satellite Surfaces; Interplanetary Spacecraft; Spacecraft Instruments

20030066093 Atmospheric and Environmental Research, Inc., Lexington, MA, USA
Science Objectives for Satellite Atmospheres, Their Circumplanetary Neutral Distributions, and Their Magnetospheric Impact and Interactions
Smyth, W. H.; Marconi, M. L.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 76; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The atomic and molecular species in the atmospheres of the Galilean satellite provide a direct link to surface processes and interior composition. The structure and abundance of gases in the atmospheres are established by the flow of gases (or supply rates) between the satellite surface, the bound atmosphere, and the extended neutral clouds of gravitationally escaping gases. The distribution and loss of these gases are also shaped by their interactions with the planetary magnetosphere, and these gases consequently supply ions to and alter the properties of the planetary magnetosphere. This overall complex flow of gases from the satellite has been best studied for Io, which is known to supply the dominant plasma source for the heavy-ion (O(+), O(++), S(+), S(++), S(+++)) plasma torus and larger planetary magnetosphere. Recent measurements from Cassini mission of unexpected copious quantities of energetic neutral atoms (ENAs) created by the charge exchange of energetic ions and circumplanetary neutrals have suggested that Europa may play a similar role near its orbit but with an order of magnitude or so smaller gas flow rates than that of Io. The situation for Ganymede and Callisto should be similar in nature with likely even smaller gas flow rates, but relevant observations are generally lacking. The orbiting encounter of the Jupiter Icy Moons Orbiter (JIMO) with each of the three outer Galilean satellites thus provides a unique opportunity to study for the first time the structure and composition of these atmospheres, their connection with the satellite surfaces, and their impact on and interactions with the planetary magnetosphere. Observations acquired between these encounter-times also allow a more in-depth remote study of the corresponding picture for Io and the plasma torus and the supply of important data not obtained by the Galileo mission.
Derived from text
Galilean Satellites; Satellite Atmospheres; Satellite Surfaces; Planetary Magnetospheres; Magnetohydrodynamic Flow; Gas Flow; Plasmas (Physics); Atmospheric Composition; Spacecraft Instruments

20030066094 NASA Ames Research Center, Moffett Field, CA, USA
The Importance of Chaos and Lenticulae on Europa for the JIMO Mission
Spaun, Nicole A.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 79; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The Galileo Solid State Imaging (SSI) experiment provided high-resolution images of Europa's surface allowing

identification of surface features barely distinguishable at Voyager's resolution. SSI revealed the visible pitting on Europa's surface to be due to large disrupted features, chaos, and smaller sub-circular patches, lenticulae. Chaos features contain a hummocky matrix material and commonly contain dislocated blocks of ridged plains. Lenticulae are morphologically interrelated and can be divided into three classes: domes, spots, and micro-chaos. Domes are broad, upwarped features that generally do not disrupt the texture of the ridged plains. Spots are areas of low albedo that are generally smooth in texture compared to other units. Micro-chaos are disrupted features with a hummocky matrix material, resembling that observed within chaos regions. Chaos and lenticulae are ubiquitous in the SSI regional map observations, which average approximately 200 meters per pixel (m/pxl) in resolution, and appear in several of the ultra-high resolution, i.e., better than 50 m/pxl, images of Europa as well. SSI also provided a number of multi-spectral observations of chaos and lenticulae. Using this dataset we have undertaken a thorough study of the morphology, size, spacing, stratigraphy, and color of chaos and lenticulae to determine their properties and evaluate models of their formation. Geological mapping indicates that chaos and micro-chaos have a similar internal morphology of in-situ degradation suggesting that a similar process was operating during their formation. The size distribution denotes a dominant size of 4-8 km in diameter for features containing hummocky material (i.e., chaos and micro-chaos). Results indicate a dominant spacing of 15 - 36 km apart. Chaos and lenticulae are generally among the youngest features stratigraphically observed on the surface, suggesting a recent change in resurfacing style. Also, the reddish non-icy materials on Europa's surface have high concentrations in many chaos and lenticulae features. Nonetheless, a complete global map of the distribution of chaos and lenticulae is not possible with the SSI dataset. Only <20% of the surface has been imaged at 200 m/pxl or better resolution, mostly of the near-equatorial regions. Color and ultra-high-res images have much less surface coverage. Thus we suggest that full global imaging of Europa at 200 m/pxl or better resolution, preferably in multi-spectral wavelengths, should be a high priority for the JIMO mission.
Derived from text
Europa; Satellite Surfaces; Terrain Analysis; Planetary Geology; Geomorphology; Topography

20030066095 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Laser Remote Sensing and Lidar Measurements for Planetary Bodies
Spiers, G. D.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 82; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Laser Remote Sensing and lidar have been used for earth remote sensing for a number of years however the inefficiency of laser devices has limited their application to planetary sensing where power is at a premium. The potential availability of a large amount of power for the Jupiter Icy Moons Orbiter (JIMO) opens up the potential to implement laser remote sensing for planetary bodies. Lidars have been and can be used to map terrain, measure atmospheric and surface parameters including velocity and composition. In this paper we will provide an overview of the lidar capabilities at the Jet Propulsion Laboratory and address the types of lidar measurements that could be relevant to JIMO science investigations.
Derived from text
Remote Sensing; Radar Measurement; Laser Applications; Thematic Mapping; Satellite Surfaces

20030066098 Washington Univ., Seattle, WA, USA
Radar Sounding of Shallow Vertical Structure on the Icy Jovian Moons at Decimeter to Centimeter Wavelengths
Winebrenner, D. P.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 86; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

The uppermost layers of all of the icy satellites of Jupiter are likely to consist of an impure ice regolith, with thickness and composition varying between moons as well as locally on each moon. Regolith properties, including porosity and the size distribution of inhomogeneities, versus depth are presumably related, albeit perhaps not simply, to the age of the near-surface and its exposure history. Vertical profiling of regolith properties, and comparison of those properties between Europa, Ganymede, and Callisto is therefore of fundamental interest. In addition, meter-wavelength radar sounding for deep properties of the subsurface necessarily involves propagation through the regolith, with poorly known implications for such sounding. Near-surface temperatures on the icy moons are in the vicinity of 100K. Water ice and many of the other minerals likely to comprise the regolith absorb very little electromagnetic radiation at decimeter and centimeter wavelengths at such temperatures. Moreover, Earth-based radar observations show very strong back-scattering at such wavelengths from all of the icy moons, though to varying degrees. Together, these observations indicate the radar scattering regime in the regoliths is one of strong multiple scattering.
Derived from text
Galilean Satellites; Satellite Surfaces; Regolith; Microwave Sounding; Surface Properties; Microwave Frequencies; Mapping

20030066099 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Jupiter Icy Moons Tidal Signatures and Ocean Mapping from Orbit

Wu, X.; Bar-Server, Y. E.; Folkner, W. M.; Williams, J. G.; Zumberge, J. F.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 88; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Following the Galileo spacecraft encounters with Europa, Ganymede, and Callisto, evidence emerged suggesting that these Galilean moons of Jupiter may have liquid oceans underneath their icy shells. Detection of the oceans on one or all three moons will have profound implications on probability of life beyond the Earth. The icy satellites also have tidal environments that are among the strongest in the solar system. The leading time-varying tidal forcing term on the surface of Europa is at least 9 times larger than those on the inner planets. Tidal forcing on the surfaces of Ganymede and Callisto are about 10% and 7%, respectively, of that on Europa. Since a planetary body with internal fluid deforms more than an otherwise solid body, tidal measurements offer exciting opportunities to detect the oceans.

Derived from text

Galilean Satellites; Satellite Surfaces; Extraterrestrial Oceans; Satellite Atmospheres; Tides; Atmospheric Models

20030066100 NASA Ames Research Center, Moffett Field, CA, USA

Science Rationale for Jupiter Entry Probe as Part of JIMO

Young, R. E.; Spilker, T. R., et al.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 90; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

A Jupiter atmospheric entry probe as part of JIMO is a cost effective way to address fundamental science questions identified in the National Research Council Solar System Exploration Decadal Survey (SSEDS): New Frontiers in the Solar System, An Integrated Ex- ploration Strategy. Compared to either the cost of an entirely separate Jupiter mission, or the cost of JIMO itself, inclusion of such a probe on JIMO would be cost advantageous. The probe itself could be relatively simple, and could build on the Galileo Probe heritage. The SSEDS specifically identified the distribution of water across the Solar System as a Key Scientific Question. Correspondingly, knowing the water abun dance on Jupiter is fundamental to understanding almost every aspect of the evolution of the early solar nebula. The Galileo Probe obtained the abundance of several key elements in Jupiter's atmosphere, which data have already caused major rethinking of theories of how Jupiter formed and how the early solar nebula evolved. However, because of a combination of circumstances, the global abundance of the key element oxygen, in the form of water, was not obtained. Without knowledge of the jovian water abundance, further progress in understanding Solar System evolution and planet formation will be greatly inhibited. Therefore, quantifying jovian water abundance should be a goal of the very next mission to the jovian system. Such a measurement would be impossible via remote sensing from the JIMO orbiter because of the large distances the JIMO orbiter maintains from Jupiter. A Jupiter atmospheric entry probe as part of JIMO could achieve the fundamental water measurement. In order that a probe avoid repeating the Galileo probe's experience of failing to obtain the jovian water abundance, the probe should go deep, to at least 100 bars pressure. Probes to 100 bars have been accomplished many times in descending to the surface of Venus, and at 100 bars the temperature of the jovian atmosphere is 60-70 K less than the surface temperature of Venus.

Derived from text

Jupiter Probes; Jupiter Atmosphere; Water; Gas Analysis; Atmospheric Composition; Atmospheric Entry; Mission Planning

20030066101 Space Telescope Science Inst., Baltimore, MD, USA

Icy Moon Atmospheres

McGrath, M. A.; Strobel, D. F.; Feldman, P. D.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 51; In English; See also 20030066012; Copyright; Avail: CASI; A01, Hardcopy

Jupiter's icy satellites possess tenuous atmospheres that are indicative of the surface composition and chemistry of these moons, and the plasma environments in which they orbit. Gas phase measurements therefore provide important, and often unique, information about the satellite surfaces and the physical processes, such as sputtering, radiolysis, and sublimation, that they are subjected to, processes that are potentially important sources of energy and nutrients for life. We will briefly review the science drivers, which determine some of the desirable instrument/measurement capabilities.

Derived from text

Galilean Satellites; Satellite Atmospheres; Spacecraft Instruments; Spectroscopic Analysis; Mass Spectrometers

20030066102 Rhode Island Univ., Narragansett, RI, USA

Science and Engineering Potential of an Icy Moon Lander

DHondt, S. L.; Millerr, J. H.; Forum on Concepts and Approaches for Jupiter Icy Moons Orbiter; 2003, pp. 17; In English; See also 20030066012; Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We urge consideration of an Icy Moon Lander as part of the Jupiter Icy Moon Orbiter mission. Inclusion of a lander would have major advantages. It would allow scientific and engineering objectives to be met that cannot be addressed with an orbiter. It would also allow independent tests of surface and subsurface properties inferred from remote observations. It would provide invaluable engineering data for the design of a future ice or Ocean penetrator mission. We illustrate these advantages with three examples. As the first example, an acoustic profiler imbedded in the surface of an icy moon could be used to identify several subsurface properties as a function of depth. Some of these properties, such as the presence and depth (or absence) of the water/ice interface and the structure and density of the ice as a function of depth, might be independently inferred by instrumentation on an orbiter. Other properties that might be determinable with an acoustic profiler cannot be imaged from orbit. These include the shear modulus of the ice (which might be used to distinguish between rigid ice and slushy convecting ice), ocean density as a function of depth, the depth of an ocean/bedrock interface, and properties of the bedrock underlying the ocean and ice. For the second example, instrumentation on a lander could undertake direct chemical analysis of organic and inorganic compounds in the surface ice and atmosphere of an icy moon. Such analyses would directly test models of surface compositions and atmospheric composition inferred from remote observations. These analyses would also greatly advance human understanding of the chemical habitability of a Jovian icy moon by directly identifying and quantifying concentrations of nutrients, energy yielding chemicals, and carbon sources in the surface ice. Thermal studies provide the third example. Lander-based thermal measurements on the surface of an icy moon would provide an absolute calibration standard for surface temperatures inferred from remote observations. Downhole temperature measurements taken at a single site with a shallow penetrator would allow modeling of the subsurface temperature profile and independent estimation of the presence and depth (or absence) of the ice/ocean interface. In closing, we wish to emphasize that inclusion of a lander with relatively low-weight instrumentation in the JIMO mission would provide a high scientific pay-off. Because the lander instrumentation would not penetrate the ice deeply, there would be no risk of directly contaminating any underlying ocean. Such a lander might require only modest adaptation of existing technology and consequently might entail relatively low cost.
Derived from text
Galilean Satellites; Satellite Surfaces; Surface Properties; Planetary Landing; Measuring Instruments; Space Probes

92
SOLAR PHYSICS

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

20030065903 NASA Marshall Space Flight Center, Huntsville, AL, USA
Parametric Transformation Analysis
Gary, G. Allan; January 2003; 1 pp.; In English; Solar Physics Division/American Astronomical Society, 16-20 Jun. 2003, Laurel, MD, USA; Copyright; Avail: Other Sources; Abstract Only

Because twisted coronal features are important proxies for predicting solar eruptive events, and, yet not clearly understood, we present new results to resolve the complex, non-potential magnetic field configurations of active regions. This research uses free-form deformation mathematics to generate the associated coronal magnetic field. We use a parametric representation of the magnetic field lines such that the field lines can be manipulated to match the structure of EUV and SXR coronal loops. The objective is to derive sigmoidal magnetic field solutions which allows the beta greater than 1 regions to be included, aligned and non-aligned electric currents to be calculated, and the Lorentz force to be determined. The advantage of our technique is that the solution is independent of the unknown upper and side boundary conditions, allows non-vanishing magnetic forces, and provides a global magnetic field solution, which contains high- and low-beta regimes and is consistent with all the coronal images of the region. We show that the mathematical description is unique and physical.
Author
Parameterization; Solar Physics; Solar Magnetic Field; Magnetic Field Configurations

20030065937 NASA Marshall Space Flight Center, Huntsville, AL, USA
Temporal Evolution of a Streamer Complex: Coronal and In-Situ Plasma Parameters
Bemporad, A.; Poletto, G.; Suess, S. T.; Ko, Y.; Parenti, S.; Riley, P.; Romoli, M.; Zurbuchen, T.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources

In this paper we report on observations acquired by the Ultra Violet Coronagraph Spectrometer (UVCS) aboard the Solar and Heliospheric Observatory (SOHO), from 10 to 17 June 2000, at the time of a SOHO-Sun-Ulysses quadrature. UVCS took data at 1.6 and 1.9 solar radii, with a slit normal to the solar radius and centered along the radial to Ulysses. A streamer complex was sampled by UVCS, throughout the quadrature campaign, giving us the opportunity to derive plasma parameters

in different streamers, and to compare them with plasma properties measured in situ. Large Angle Spectroscopic Coronagraph (LASCO) images above 2 solar radii helped us understand the temporal evolution of the streamer complex. We derive densities, temperatures and elemental abundances in two streamers, which have different temperatures and element abundances. In spite of these differences, both structures have the same FIP bias. The Fe/O ratio, which may be considered a proxy for the FIP effect, was measured (\it in situ} by the Solar Wind Ion Composition Spectrometer (SWICS) aboard the Ulysses spacecraft. Values of Fe/O measured in the corona, at the sites where in situ plasma originated, agree with in situ Fe/O values.
Author
Ultraviolet Astronomy; Coronagraphs; Solar Wind; Ultraviolet Spectrometers; Stellar Composition; Mass Spectrometers

20030066141 NASA Marshall Space Flight Center, Huntsville, AL, USA
On a Cyclic Variation of the Hemispheric Helicity Rule
Pevtsov, A. A.; Hagyard, M. J.; Blehm, Z.; Smith, J. E.; Canfield, R. C.; Sakurai, T.; [2003]; 1 pp.; In English; International Astronomical Union Conference, 16 Jul. 2003, Sydney, Australia; Copyright; Avail: Other Sources; Abstract Only

We report the result of a study magnetic helicity in solar active regions during 1980-2000.Using the vector magnetograms four different instruments we calculated the force-free parameter alpha as in Pevtsov et al.(1995). We use alpha as the proxy for current helicity density.
Author (revised)
Magnetic Signatures; Solar Cycles; Annual Variations

93
SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

20030066163 NASA Marshall Space Flight Center, Huntsville, AL, USA
Relative Abundances and Energy Spectra of C, N, and 0 as Measured by the Advanced Thin Ionization Calorimeter Balloon Experiment
Fazely, A. R.; Gunasingha, R. M.; Adams, J. H.; Ahn, E. J.; Ahn, H. S.; Bashindzhagyan, G.; Case, G.; Chang, J.; Christl, M.; Ellison, S., et al.; [2003]; 1 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul. - 7 Aug. 2003, Tsukuba, Japan; Copyright; Avail: Other Sources; Abstract Only

We present results on the spectra and the relative abundances of C, N, and 0 nuclei in the cosmic radiation as measured from the Advanced Thin Ionization Calorimeter Balloon Experiment (ATIC) . The ATIC detector has completed two successful balloon flights from McMurdo, Antarctica lasting a total of more than 35 days. ATIC is designed as a multiple, long duration balloon flight, investigation of the cosmic ray spectra from below 50 GeV to near 100 TeV total energy, using a fully active Bismuth Germanate calorimeter. It is equipped with a large area mosaic of silicon detector pixels capable of charge identification from H to Fe. As a redundancy check for the charge identification and a particle tracking system, three projective layers of x-y scintillator hodoscopes were employed, above, in the middle and below a 0.75 nuclear interaction length graphite target.
Author
Energy Spectra; Carbon; Oxygen; Nitrogen; Cosmic Rays; Calorimeters; Balloon Flight

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